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No. 95-475

In The

Supreme Court of the United States

October Term, 1995

SOUTHWALL TECHNOLOGIES, INC.,

Petitioner,

v.

CARDINAL IG COMPANY,

Respondent.

On Petition For A Writ Of Certiorari To The United States Court Of Appeals For The Federal Circuit

PETITION FOR A WRIT OF CERTIORARI

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17 pp

QUESTION PRESENTED

As courts rely on a patent's file history, as required by *Markman v. Westview Instruments, Inc.*[1], to properly interpret one of many patent claims which particularly point out and distinctly claim the invention (35 U.S.C. § 112), must a court, as a matter of law, trace the lineage of that patent claim to assure that its interpretation is affected only by the portion of the file history which pertains to that claim?

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[1] 52 F.3d 967 (Fed.Cir.1995) (*en banc*), *petition for cert. filed*, 64 U.S.L.W. 3068 (U.S. July 3, 1995) (No. 95-26).

LIST OF PARTIES TO THE PROCEEDING PURSUANT TO RULES 14(1)(b) AND 29.1

The names of all parties in the court whose judgment is sought to be reviewed appear in the caption of this Petition for Writ of *Certiorari*.

LIST OF PARTIES PURSUANT TO RULE 29.1

Petitioner Southwall Technologies, Inc. does not have any parent companies or subsidiaries.

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On Petition For A Writ Of Certiorari To The United States Court Of Appeals For The Federal Circuit

PETITION FOR A WRIT OF CERTIORARI

Southwall Technologies, Inc. respectfully petitions for a writ of *certiorari* to review the judgment of the United States Court of Appeals for the Federal Circuit.

OPINIONS BELOW

The opinion of the Court of Appeals is reported at 54 F.3d 1570 (Fed. Cir. 1995), and is reproduced beginning at Appendix page 1a. The unpublished opinion of the district court is attached beginning at 33a.

JURISDICTION

The judgment of the Court of Appeals was entered on May 10, 1995. 1a. The petition for rehearing and suggestion for rehearing *en banc* was denied by the Court of Appeals on June 21, 1995. 59a. The jurisdiction of this Court is invoked under 28 U.S.C. § 1254(1).

FEDERAL STATUTE INVOLVED

The following federal statute is involved in this case:

35 U.S.C. § 112 prescribes that

> the patent specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains . . . to make and use the same . . . [and that] the specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention. A claim may be written in independent or, if the nature of the case admits, in dependent or multiple dependent form. . . . A claim in dependent form shall contain a reference to a claim previously set forth and then specify a further limitation of the subject matter claimed. A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers. . . .

STATEMENT OF THE CASE

This case presents the question of whether to properly interpret one out of a number of patent claims, where each claim particularly points out and distinctly claims the invention, a court must, as a matter of law, trace the lineage of that particular claim through the patent's file history. The Federal Circuit has recently held that interpretation of a disputed term in a patent claim is strictly a question of law. *Markman v. Westview Instruments, supra.*[2] As Circuit Judge Mayer observed in his concurrence in *Markman*, "[a]ll these pages and all these words cannot camouflage what the court well knows: to decide what the claims mean is nearly always to decide the case." 52 F.3d at 989. *Markman* now mandates that courts are the sole interpreters of the indisputable record of the patent's file history. 52 F.3d at 979.

In its *de novo* review of the asserted claims, the Federal Circuit limited the scope of the asserted claims by interpreting a disputed term in those claims based on arguments made by the patent applicant to the Patent Office with respect to completely unrelated claims. The Federal Circuit declined to make any effort to separately consider the various claims and arguments in historical

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[2] This case, decided on summary judgment, was only the second published decision of the Federal Circuit in which *Markman* was applied to resolve the meaning of a disputed term in a patent claim.

context, and to separately consider the different claims with respect to one another, stating that:

> Given the metamorphosis that claims often go through during prosecution, it is often impossible to trace the lineage of the finally allowed claims to decide which arguments pertained to which claims. Therefore, that Southwall might have made the arguments distinguishing [the prior art] with regards to versions of the claims not now at issue does not avoid those arguments limiting later or different versions of the claims.

30a. To allow any argument to be taken out of context from the patent's history and applied against any one of the claims, without regard to the particular lineage of the selected claim, is contrary to the patent statutes, the law of this Court, and to the law of the Federal Circuit.[3]

Because both infringement and validity of patents frequently turn on the interpretation of disputed terms in patent claims, and because the Federal Circuit has exclusive appellate jurisdiction in all patent cases, the decision below will profoundly affect the trial of virtually every patent infringement action throughout the Nation. Furthermore, this decision will affect the legal advice to be rendered on every United States patent containing multiple claims, and affects the prosecution of nearly every pending patent application.

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[3] Particularly where summary adjudication is involved, this analytical shortcut inevitably will lead to a denial of due process and deny the patent owner's right to a jury trial.

A. The Patent And Its Relevant History.

Petitioner Southwall is the owner of the reexamined United States Patent No. B1 4,799,745 titled "Heat Reflecting Composite Films and Glazing Products Containing the Same." 91a. The claims asserted by petitioner are claims 14 and 36, which define a thin film coating made by applying sequentially deposited layers to glass. The stack of layers creates a filter which blocks heat but allows visible light to pass through.

Each layer is applied using a machine called a "magnetron sputterer" which "sputters" very uniform, thin layers of these materials onto glass in a vacuum chamber. Two different types of materials – metals and dielectrics – are alternately applied to the glass to produce the appropriate filtering effect. The resulting product consists of a 5-layer stack, consisting of, from the glass surface and working upward, dielectric, metal, dielectric, metal, and dielectric layers.

The disputed term in claims 14 and 36 is the phrase "sputter-deposited dielectric."[4] The patent specification

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[4] Claim 14 in its entirety reads as follows:

14. A visually transparent, infrared reflecting composite film comprising a transparent support having adhered to one surface thereof an interference filter having a plurality of continuous directly contiguous stacked layers, said layers comprising:

a. a dielectric layer,

b. a discrete sputter-deposited transparent metal layer,

c. one or more pairs of layers, each pair comprising a dielectric spacer layer and a discrete sputter-deposited transparent metal layer, and

sets forth specific definitions for the terms "sputter-deposited" and "dielectrics." 74a. "Sputter-deposited" is defined as the product of the process in which a layer of material is laid down by the use of a magnetron sputterer. "Dielectrics" are nonmetallic materials which are transparent. Generally, dielectrics are inorganic oxides (including metal oxides), but other materials such as organic polymers may be included as well. Yet here, the court adopted a very narrow definition for these previously defined terms as used conjunctively in the claims being asserted.

The specification contains no explicit definition for the phrase "sputter-deposited dielectric." Dielectric layers can be deposited by a magnetron sputterer in the form of a dielectric, or, in proper conditions, first deposited in the form of a metal and later oxidized so that the metal is converted into dielectric. Either technique ultimately produces a dielectric layer.

1. The Originally Filed Claims.

The patent application leading to petitioner's patent was filed in June, 1986. As is typical, the application was filed with multiple groups of related claims to present different definitions of the invention having varying

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d. a dielectric outer layer, wherein the dielectric layer is a sputter-deposited dielectric;
the metal layers each comprise silver and each are from 4 to 17 nm in thickness and the dielectric layers each have an index of refraction of from about 1.75 to about 2.25 with the spacer layers having a thickness of from 70 to 100 nm and outer layers having a thickness of from about 30 nm to about 70 nm.

scope. 35 U.S.C. § 112. The original application contained 32 different claims, five of which were different independent claims to define the invention. 100a-104a.

A number of the patent claims originally filed in the initial patent application contained the requirement that the dielectric layers be sputter-deposited.[5] Other unrelated claims in the initial application contained similar limitations requiring that the dielectric layer be sputter-deposited, i.e., application claim 5 required "wherein the dielectric layers are sputter-deposited." 100a.

Patent examiners carefully track the evolution or metamorphosis of individual patent claims throughout the examination process. They follow strict procedures to assure the numbering of claims is kept in order and that amendments are properly noted. 37 C.F.R. § 1.126. The examiners use a system of handwritten notations which assist them, and any persons who later examine the file history, in tracing the lineage of any of the claims. When patents are reviewed and the file history is obtained from the Patent Office, these notations are understood to allow systematic tracing of any claim's lineage.[6]

By tracing the lineage of claim 14 back to the initially filed application, the disputed claim language of claim 14 can be found to have originated from the claim originally

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[5] There are alternative ways for depositing layers rather than using a magnetron sputterer, such as evaporative deposition of materials.

[6] Because this Court's rules require documents in the appendix to be typeset, the handwritten markings used for tracing which appear in the Patent Office's files do not appear in the prosecution documents in this appendix.

issued as claim number 13, which began as application claim number 16.[7]

2. The Key Patent Office Rejection and the Petitioner's Response.

In July of 1988, the Examiner rejected all of the pending claims under consideration at that time in view of a prior art patent to Franz. 107a. The Examiner noted that a number of the claims contained language to the effect that the dielectric layer must be sputter-deposited, and asked for clarification of the intended scope of this claim language:

> It is unclear whether the "metal oxide[8] is sputter-deposited" limitation is meant to encompass the situation where the metal oxide is [s]putter deposited as a metal and later oxidized. Until clarification, the examiner m[u]st interpret the claims broadly.

Id. In response to this rejection, the petitioner amended only one of the independent claims, pending application claim 4, containing the phrase "sputter-deposited

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[7] Claims are numbered sequentially during the application process. Once the examination of the application is completed, and the claims to be issued in the patent are determined, the remaining claims to be issued are renumbered sequentially. 37 C.F.R. § 1.126

[8] None of the claims contain exactly the quoted limitation mentioned by the patent examiner. "Metal oxide" appears to be used interchangeably with "dielectric." The patent specification mentions that metal oxides are commonly used for the dielectric material.

dielectric" to specify that the metal layers are to be separated from one another by a "layer of sputter-deposited inorganic metal oxide, compound or salt dielectric."[9] 111a. By so amending claim 4, the applicant was presenting for consideration a new version of claim limited to a new subgroup or "species" of the generic limitation "sputter-deposited dielectric." Other independent claims including the limitation that required sputter-depositing the dielectric were left unchanged. Specifically, one of claim 14's predecessors, issued claim 13, was not amended with respect to sputter-depositing the dielectric layers.

When read in the proper context, giving separate consideration to each of the patent claims, the petitioner's decision *not* to amend the other claims which included language concerning the sputter-deposition of the dielectric layers demonstrates the petitioner's acceptance of the examiner's stated position: those claims *not* amended must be interpreted broadly to encompass situations where the dielectric is sputter-deposited as a metal and later oxidized. Claim 14 should have been so broadly interpreted.

The petitioner explicitly explained the amendment of claim 4 by stating that

> [i]t is believed that the claims as last presented distinguished patentably over the Franz and Yatabe disclosure but to provide yet additional clear bases for distinction the claims have been

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[9] The underlined text indicates the language added by the amendment. Other claims dependent from this amended claim thus included this amendment as well.

> amended to specify that the dielectric layer is laid down as a sputter-deposited inorganic metal oxide, compound or salt.

115a. Since the only claims so amended are claim 4 and claims depending from it, only those claims pertain to this argument. These narrower amended claims are limited to a particular species of dielectrics,[10] rather than the broad genus of dielectrics permitted in the other claims which were not narrowed.

Amended claim 4 was eventually cancelled during the pendency of the patent application and is not related to the lineage of the claims being asserted (14 and 36). At the time of the relevant amendment and argument, the predecessor of claim 14 (application claim 20) contained the same language now in dispute – "wherein the dielectric is a sputter-deposited dielectric."

The patent claims were eventually allowed for reasons related to the specific dimensions set forth in the claims to define a properly "tuned" filter to exclude heat, but allow the passage of visible light through the coating. 124a.

During the reexamination of Southwall's patent, in an amendment filed in October, 1991, claims 14 and 36[11] were amended into their current form. 126a, 131a.

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[10] For instance, diamond or organic polymers would constitute a sputter-deposited dielectric which would not fall in the species category of inorganic metal oxide, compound or salt dielectrics.

[11] Claim 36 was added as a new claim during the reexamination process, and differs from claim 14 only in the thickness range specified for one of the layers.

B. The Accused Product.

Respondent Cardinal IG Company manufactures a thin film coating applied to glass using a magnetron sputterer which results in a filter which blocks heat and passes visible light. This coated glass product is used in the windows of residential and commercial buildings. The product contains a five-layer stack of alternating dielectric and metal layers, meeting the required thicknesses and optical properties specified in claims 14 and 36.

During the process of making the accused product, one small portion of two of the dielectric layers is initially deposited as a metal layer, which then automatically converts into a dielectric layer during the manufacturing process. Referred to as a "sacrificial" layer, the use of this layer is designed to protect the fragile metal layers as they are being subsequently deposited on the stack. For purposes of the summary judgment motion, it was conceded that each sacrificial layer merged indistinguishably into the adjacent dielectric layer, in a stack meeting the dimensions specified in the claims.

The sole focus of the infringement analysis was whether the sacrificial layer was a "sputter-deposited dielectric" layer.

C. The District Court Litigation.

Petitioner sued respondent for patent infringement under 35 U.S.C. § 281. Respondent brought a motion for summary judgment of noninfringement and invalidity under Fed. R. Civ. P. Rule 56. After initial briefing, oral

argument, and supplementary briefing, the district court found that triable issues of fact remained as to the validity of the patent, but found no literal infringement and no infringement under the doctrine of equivalents as a matter of law.

Both parties submitted considerable documentary evidence relating to the lineage of claims 14 and 36 of the patent, and the relationship of those claims to the arguments made to overcome the Franz patent in their briefs.

The district court decision included its own valiant attempt to trace the lineage of claim 14 and the arguments to overcome Franz. 38-48a. In the end, the district court drew no distinction between the amended species claim, and the predecessor of claim 14 requiring any sputter-deposited dielectric. Because the words "sputter-deposited" and "dielectric" were common to both the amended claim and claim 14, the district court applied the arguments made to overcome the Franz patent to both. The court failed to appreciate the difference the generic claim (which led to claim 14) and the species claim (which was cancelled). Thus, the district court found that the arguments made by petitioner to overcome the Franz patent with respect to the species claim necessarily limited the meaning of "sputter-deposited dielectric" to exclude the sacrificial layers, and therefore there was no infringement, either literal or under the doctrine of equivalents.

D. Federal Circuit Opinion.

The Federal Circuit panel affirmed the grant of summary judgment of noninfringement. In its *de novo* review

of the meaning of the disputed claim phrase, the Federal Circuit drew no distinction between, and equated the meaning of "sputter-deposited dielectric," with the meaning of "sputter-deposited inorganic metal oxide, compound or salt dielectric." 11a. Again, there was no recognition that there were two different claims at issue. The Federal Circuit gave no weight to the extrinsic evidence presented that persons skilled in the art viewed the sacrificial layers in respondent's product as "sputter-deposited dielectric" layers. 15a.

Despite the extensive effort expended by both parties with respect to assisting the court in following the lineage of the claim phrase "sputter-deposited dielectric" in claim 14 through the prosecution of the patent, the Federal Circuit declined to even attempt to trace the lineage of claim 14 as part of the interpretive process. In both the analysis of literal infringement and infringement under the doctrine of equivalents, the Federal Circuit did not trace the lineage of the disputed claim language.[12] As to literal infringement, at footnote 7 of its decision, the Federal Circuit found that the common usage of the words "sputter-deposited" and "dielectric" meant that the argument made to distinguish over the Franz patent applied universally to both the narrow claim and the broad claim.[13] 11a. No effort was made to preserve the

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[12] In its analysis, the Federal Circuit employed arguments in the file history regarding the Franz reference for purposes of interpreting claims for literal infringement, and also as the basis for forming a prosecution history estoppel under the doctrine of equivalents.

[13] Ignoring the presence of the key language added by amendment to modify "dielectric" in claim 4, the Federal Circuit

proper context by correlating the argument with the particular claim amended at the time, resulting in the wholesale emasculation of all claims containing the broad language "sputter-deposited dielectric."

With respect to the doctrine of equivalents, the refusal to keep the arguments and amendments in context was more bluntly expressed: "[T]hat Southwall might have made the arguments distinguishing Franz with regard to versions of the claims not now at issue does not avoid those arguments limiting later or different versions of the claims." 30a. As justification, the Federal Circuit then cited the supposed complexity of the tracing process. That "given the metamorphosis that claims often go through during prosecution, it is often impossible to trace the lineage of the finally allowed claims to decide which arguments pertained to which claims."[14]

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then stated that the disputed language "sputter-deposited dielectric" cannot be interpreted differently in different claims because claim terms must be interpreted consistently, citing *Fonar Corp. v. Johnson & Johnson*, 821 F.2d 627, 632 (Fed. Cir. 1987), *cert. denied*, 484 U.S. 1027 (1988). In this case, the presence of different language in different claims was erroneously disregarded.

[14] This Court has long recognized that claim tracing can be an extremely difficult task. In an earlier complaint about the complexities in untangling a multiplicity of patent claims, this Court quoted Judge Learned Hand's comment that "it takes the scholastic ingenuity of a St. Thomas with the patience of a yogi to decipher their meaning, as they stand." *Williams Mfg. Co. v. United Shoe Mach. Corp.*, 316 U.S. 364, 375 (1942). However, that the analysis is painstaking and time consuming does not relieve a court of its obligation to trace claims in order to properly interpret the language. The entirety of the file history must be viewed in context.

REASONS FOR GRANTING THE WRIT

This Court should grant *certiorari* to decide whether courts relying on the undisputed record of a patent's file history, as required by the *Markman* case, must trace the lineage of one claim selected out of multiple claims, to assure that only those arguments pertaining to the selected claim are used in its interpretation. To answer this question in the negative would violate the intent underlying the patent statute, 35 U.S.C. § 112, which permits an invention to be defined by multiple claims in a patent. The Federal Circuit ignored the precedent of this Court and its own decisions, and rendered meaningless the provision for multiple claims in the patent statute.

The Federal Circuit decision completely undermines the fundamental principles of American patent law practice in which multiple claims are presented for the patent office's consideration. The holding below contradicts the most fundamental principles of the prosecution of separate claims in a patent application, and the proper analysis to be undertaken in interpreting the indisputable history of a patent claim. Taken to its logical conclusion, the Federal Circuit's holding allows any argument made during any part of the prosecution process to be taken out of context and used to limit the scope of any claim of the issued patent.

I. THE QUESTION PRESENTED IS ONE OF EXTRAORDINARY NATIONAL IMPORTANCE THAT LOWER COURTS WILL NOT FURTHER ANALYZE

A. The Question Presented Has A Recurring And Important Effect.

This case affects nearly every patent in the United States. This case is important because it affects the interpretation of every patent containing more than one claim, and in which there was argument made to gain allowance of the patent. This case affects not only such patents which are the subject of litigation, but also patent applications which are being prosecuted before the Patent and Trademark Office, and issued patents on which counsel are asked to opine as to their scope for infringement and validity.

The *Markman* decision requires courts to decide as a matter of law, every question of patent claim interpretation. The lineage of patent claims as found in the patent file history is the blueprint of every patent. In the post-*Markman* world, judges will be required to construe a patent claim either with respect to infringement or validity. Resolution of the question presented is thus critical to instructing all courts facing the claim interpretation issue. This guidance is critical, as resolving the meaning of the disputed patent claim language for all intents and purposes decides these cases.[15] Since the Federal Circuit has exclusive jurisdiction over appeals from

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[15] In the context of a summary judgment motion, the importance of claim construction has significantly intensified. Parties may no longer avoid summary judgment by demonstrating that triable issues of fact exist over the disputed meaning of

all of the district courts in patent cases, 28 U.S.C. § 1295(a)(1), the Federal Circuit's decision below governs the district courts' construction of patent claims. To assure consistency in the law, interested parties need assurance that a court will "apply the established rules of construction" to "arrive at the true and consistent scope of the patent owner's rights to be given legal effect." *Markman*, 52 F.3d at 979. Patent attorneys and patent agents prosecuting patents before the Patent Office must be assured that the arguments made to overcome prior art have a predictable effect on the various patent claims being sought. Attorneys that evaluate patents must be assured that the proper analytical method has been applied in interpreting the meaning of the patent claims. Therefore, it is imperative that this Court resolve the question presented.

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a claim term. Judges will resolve all such issues as a matter of law, while taking into account well established principles of summary judgment analysis, such as the requirement that the evidence must be viewed in the light most favorable to the nonmoving party. *SRI Int'l v. Matsushita Elec. Corp. of America*, 775 F.2d 1107, 1116 (Fed. Cir. 1985) (*en banc*); *see also, U.S. v. Diebold, Inc.*, 369 U.S. 654, 655 (1962) (district court must draw all inferences in favor of nonmovant). The district court must proceed in a motion for summary judgment of noninfringement "with a care proportionate to the likelihood of its being appropriate." *D.M.I., Inc. v. Deere & Co.*, 755 F.2d 1570, 1573 (Fed. Cir. 1985). Without guidance on the analysis to be undertaken in interpreting disputed claim language via a review of the patent's prosecution history, the application of these principles is unpredictable in patent cases.

II. THE DECISION REACHED BELOW IS IN CONFLICT WITH DECISIONS OF THE SUPREME COURT

A. The Patent Statute Contemplates Separate Consideration Of Claims.

United States patents are obtained through an *ex parte* negotiation process before the Patent Office, in which multiple claims of varying scope are presented for consideration. The patent statute specifically provides for the definition of the invention of a patent in one or more patent claims. Patents commonly contain multiple claims of varying scope to define the invention as required by 35 U.S.C. § 112.

Inherent in the statutory requirements of Section 112 is that each claim stands alone in defining the invention, and should be given separate consideration and effect. It would be futile and meaningless to provide for such multiple claims in a single patent unless each had significance. It is the claims which define the metes and bounds of the invention entitled to the protection of the patent system. *Zenith Lab. Inc. v. Bristol-Myers Squibb Co.*, 19 F.3d 1418, 1424 (Fed. Cir.), *cert. denied*, ___ U.S. ___, 115 S.Ct. 500 (1994).

B. Each Claim Is To Be Given Separate Meaning And Effect.

Each claim of a patent stands or falls, as itself sufficiently defining invention, independently of other claims. *Altoona Publix Theatres, Inc. v. American Tri-Ergon Corp.*, 294 U.S. 477, 487 (1935) (disclaimer case reviewing claims as originally issued with revised claims). Each claim

defines a separate invention. *Jones v. Hardy*, 727 F.2d 1524, 1528 (Fed. Cir. 1984). The rule is well established that the scope of each individual claim must be examined on its own merits, apart from other claims, even in the same patent. *Lemelson v. TRW, Inc.*, 760 F.2d 1254, 1267 (Fed. Cir. 1985).

Tracing the lineage of the disputed claims is certainly not "often impossible" as the Federal Circuit asserts. The numbering system for claims in a patent application is specifically designed to facilitate a standardized way of tracing of claims through the prosecution history of the patent. 37 C.F.R. § 1.126 (1994); Manual of Patent Examining Procedure (6th ed. (Jan. 1995)) ("M.P.E.P.") 608.01(i),(j),(k),(n). A prescribed method for adding and amending claims also assures that the lineage of claims is easily traceable. 37 C.F.R. §§ 1.119, 1.121 (1994).

To properly trace a claim's lineage merely requires a chronological review of the evolution of the claims in the issued patent. The patent examiners use a system of handwritten notations in the official Patent Office file to assist them in tracing the lineage of and extent of any changes in any of the claims. This notation system is understood to allow tracing the lineage of any claim.

If the meaning and scope of "sputter-deposited dielectric" in claim 14 had indeed changed by the time petitioner's patent issued, as the Federal Circuit held it had, Patent Office procedures required that the summary of the invention in the patent should have been modified to reflect these changes.

> Frequently, the invention as originally described and claimed was of much greater scope than

> that defined in the claims as allowed. Some of much of the subject matter disclosed may be entirely outside the bounds of the claims accepted by the applicant. In such case, the examiner should require the applicant to modify the brief summary of the invention and restrict the descriptive matter so as to be in harmony with the claims.

M.P.E.P. 1302.01. *See also*, 37 C.F.R. §§ 1.71 and 1.73, M.P.E.P. 608.01(d). Since none of this occurred in petitioner's patent, the meaning of "sputter-deposited dielectric" did not change from the original definitions provided. The Federal Circuit's decision contradicts this rule of practice.

C. The Doctrine of Claim Differentiation Supports The Requirement Of Tracing The Claim's Lineage.

Tracing the lineage of a claim to interpret it is also inherent to the application of the long-established doctrine of "claim differentiation" which provides that it is improper for courts to read into an independent claim a limitation another claim set forth explicitly. *Whittaker Corp. v. UNR Industries, Inc.*, 911 F.2d 709, 712 (Fed. Cir. 1990); *United States v. Telectronics, Inc.*, 857 F.2d 778, 783-84 (Fed. Cir. 1988), *cert. denied*, 490 U.S. 1046 (1989); *Environmental Designs Ltd. v. Union Oil Co. of California*, 713 F.2d 693, 699 (Fed. Cir. 1983), *cert. denied*, 464 U.S. 1042 (1984). *See T.H. Symington Co. v. National Malleable Castings Co.*, 250 U.S. 383, 385 (1919) ("the difference in terms points permissively to a difference in purpose"). Courts should usually not by interpretation introduce

into a claim limitations that are explicitly contained in other claims. *Caterpillar Tractor Co. v. Berco, S.p.A.*, 714 F.2d 1110, 1116 (Fed. Cir. 1983). Failure to differentiate between different claims constitutes legal error. *Grain Processing Corp. v. American Maize Prods. Co.*, 840 F.2d 902, 911 (Fed. Cir. 1988); *Palumbo v. Don-Joy Co.*, 762 F.2d 969, 977 (Fed. Cir. 1985). In patents containing different independent claims, it is not unusual that separate claims may define the invention using different terminology. *Hormone Res. Found., Inc. v. Genentech, Inc.*, 904 F.2d 1558, 1567 n. 15 (Fed. Cir. 1990), *cert. dismissed*, 499 U.S. 955 (1991).

An illustrative example of differentiating between claims of differing scope is found in *United States v. Adams*, 383 U.S. 39 (1966). In that case, in the context of determining the validity of the patent claims being asserted for a water-activated battery, this Court noted that claims 1 and 10 of the Adams patent contained no mention of the type of electrolyte to be used for the battery, although a stated object of the invention was to provide a battery rendered serviceable by the mere addition of water. However, three other narrower claims in the same patent contained specific references to water or certain salts for the electrolyte.

The Court held that the absence of any mention of any electrolyte in eight of the patent's claims by implication meant that claims 1 and 10 broadly covered batteries which used water as its electrolyte. 383 U.S. at 48-49. By differentiating between claims, this Court found that there was no connection between the lineage of the claims being asserted (claims 1 and 10) which were silent on the

required electrolyte, and narrower claims specifying particular electrolytes. Thus, this Court traced the lineage of the asserted claims to determine their effect.

In the present case, the asserted patent claim contained the phrase "sputter-deposited dielectric." Another unrelated patent claim, which had been rejected during the course of the patent's examination, contained the different and narrower phrase "sputter-deposited inorganic metal oxide, compound or salt dielectric."[16] The latter claim expression describes a "species" of the former claim describing a "genus" which is dielectrics. These two claim phrases clearly differ in scope, since there are some dielectrics which fall outside the specified category of "inorganic metal oxide, compound or salt dielectrics" such as diamond, or organic polymers. *See, supra,* note 10.

In its opinion, the Federal Circuit concluded that the term "sputter-deposited dielectric" must be narrowly interpreted consistently in all claims. 17a. To reach this conclusion, the Court ignored the differences between claim 14's predecessor and the abandoned claim 4. This rule would be appropriate to apply if the term "sputter-deposited dielectric" was defined, in the specification or through arguments to the PTO, as an isolated, free standing term. However, such is not the case here: petitioner used at least considerably different terms – "sputter-deposited dielectric" and "sputter-deposited inorganic metal oxide, compound or salt dielectric" – in its patent claims to convey two different scopes of invention. Thus,

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[16] The underlined text indicates the portion of the phrase which was added by an amendment of a prior version of that claim.

the rule relied upon by the Federal Circuit is inapplicable here. To apply the arguments made solely with respect to the species claim to limit the meaning and scope of the generic claim, without regard to the very separate lineage of these two claims clearly constitutes reversible, legal error.

D. This Court's Precedents Support Tracing A Claim's Lineage By Comparing A Narrower Allowed Claim Against A Broader, Rejected Claim.

This Court has consistently considered other claims of the patent, including rejected claims, or other issued claims in order to determine the claim's meaning. This body of law is consistent with the Federal Circuit's precedents. *See, e.g., E.I. duPont de Nemours & Co. v. Phillips Petroleum Co.*, 849 F.2d 1430, 1438 (Fed. Cir.), *cert. denied*, 488 U.S. 986 (1988).

Most often, this Court has addressed situations where the patentee sought to apply a narrowed patent claim against an alleged infringer, by attempting to broaden the scope of the asserted claim to cover what was previously claimed in broader, rejected claims. The authorities are replete for the proposition that, where an applicant for a patent to cover a new combination is compelled by the rejection of his application by the Patent Office to narrow a claim by the introduction of a new element, the applicant cannot, after the issue of the patent, broaden that claim by dropping the element which the applicant was compelled to include in order to secure

the patent.[17] In each of these earlier cases, the claim being asserted was examined as compared to other claims previously rejected in order to interpret the scope of the asserted claim. Such a comparison is a fundamental application of tracing the lineage of the asserted claim.

E. This Court's Precedents Include Tracing Claim Lineage Where The Asserted Claim Is Broader Than The Narrower Rejected Claim.

The more typical case has been where the claim being asserted is narrower than broadened claims which were rejected. The present case presents the inverse situation, where the asserted claim is broader than a narrower claim which was rejected.

The concept of tracing the lineage of a claim in claim interpretation equally applies to situations where a broad claim was allowed and is being asserted, and a narrower claim was previously rejected. In either circumstance, "[i]t is a rule of patent construction consistently observed

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[17] *See Leggett v. Avery*, 101 U.S. 256, 259 (1880); *Goodyear Dental Vulcanite Co. v. Davis*, 102 U.S. 222, 228 (1880); *Fay v. Cordesman*, 109 U.S. 408, 420 (1883); *Mahn v. Harwood*, 112 U.S. 354, 359 (1884); *Union Metallic Cartridge Co. v. U.S. Cartridge Co.*, 112 U.S. 624, 644 (1884); *Shepard v. Carrigan*, 116 U.S. 593, 597 (1886); *Sutter v. Robinson*, 119 U.S. 530, 540 (1886); *Roemer v. Peddie*, 132 U.S. 313, 317 (1889); *Phoenix Caster Co. v. Spiegel*, 133 U.S. 360, 366 (1890); *Corbin Cabinet Lock Co. v. Eagle Lock Co.*, 150 U.S. 38, 40 (1893); *Knapp v. Morss*, 150 U.S. 221, 227 (1893); *Hubbell v. United States*, 179 U.S. 77, 80 (1900); *I.T.S. Rubber Co. v. Essex Rubber Co.*, 272 U.S. 429, 443 (1926); *Smith v. Magic City Kennel Club, Inc.*, 282 U.S. 784, 789 (1931); *Graham v. John Deere Co.*, 383 U.S. 1, 33 (1966).

that a claim in a patent as allowed must be read and interpreted with reference to claims that have been cancelled or rejected and the claims allowed cannot by construction be read to cover what was eliminated from the patent." *Schriber-Schroth Co. v. Cleveland Trust Co.*, 311 U.S. 211, 220-221 (1940), *citing Morgan Envelope Co. v. Albany Perforated Wrapping Paper Co.*, 152 U.S. 425, 429 (1894). In either circumstance, the common thread is that tracing the lineage of the asserted claim is mandated.

An illustrative case in which early narrow claims were rejected, but were found to have no bearing on the assertion of a broader claim which issued in the patent is found in *Smith v. Snow*, 294 U.S. 1 (1935). The patent in this case related to an incubator for artificially hatching eggs using a system for holding an assortment of eggs to which heated air was applied. The original patent application was filed with a total of 25 claims. The Court first stated the general rule that a "patentee cannot broaden his claim by dropping from it an element which he was compelled to add in order to secure his patent [citations omitted]. But the file wrapper lends no support for the application of this rule to petitioner's claim 1." 294 U.S. at 15.

In interpreting the broad claim being asserted, claim 1, the Court performed an elaborate tracing of this claim's evolution:

> The history of Smith's application in the Patent Office is a long one. Four groups of method claims were successively presented to the Patent Office, and three were successively rejected. The fourth group ultimately matured into claims 1, 2 and 3 of the patent. . . . It is an illuminating fact

> that the entire written argument filed in support of claim 1, as it was finally presented to the Patent Office and allowed, makes no reference to [various features found in the narrower claims]. . . . We find nothing in the file wrapper to suggest that any addition was made to claim 1 to restrict the patent to any particular order of arrangement of the eggs, . . . and nothing to estop the patentee from asserting that the claim is not restricted by such features. [citations omitted] It is of no moment that in the course of the proceedings in the Patent Office the rejection of narrow claims was followed by the allowance of broader claim 1.

Id. Thus, the Court undertook the effort to trace the lineage of claim 1 to assure that its lineage did not include other limitations that would exclude the accused incubator from infringement. As a matter of law, this tracing was integral to the proper interpretation of the asserted claim. *See also, Weber Electric Co. v. E.H. Freeman Electric Co.*, 256 U.S. 668 (1921); *Phoenix Caster Co. v. Spiegel*, 133 U.S. 360 (1890).

F. Had the Federal Circuit Properly Traced The Lineage of the Asserted Claims, Infringement Would Have Been Found.

Had the Federal Circuit properly traced the lineage of claims 14 and 36, "sputter-deposited dielectric" would have been interpreted broadly to encompass respondent's sacrificial layer, resulting in a *sua sponte* finding of infringement. "Sputter-deposited dielectric" should be read to "encompass the situation where the [dielectric] is sputter-deposited as a metal and later oxidized" to form a

dielectric layer. 107a. The case would have been decided in petitioner's favor.

CONCLUSION

Tracing the lineage of patent claims through their prosecution history is inherent to the multi-claim structure of United States patents. In the post-*Markman* world of patent claim interpretation, tracing a claim's lineage to assess the meaning of a disputed term is a mandatory step of the process that the court must apply. That the metamorphosis of a claim, as compared against other claims in the same patent, has been acknowledged and accounted for is continuously evident in the decisions of this Court since the late 1800s. To allow the Federal Circuit decision to disavow this principle would throw every opinion rendered on a patent and every patent being litigated into question. The Petition for a Writ of *Certiorari* should be granted. This principle affects every patent being applied for in the Patent Office.

September 19, 1995

Respectfully submitted,

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54 F.3d 1570
34 U.S.P.Q.2d 1673
(Cite as: 54 F.3d 1570)

SOUTHWALL TECHNOLOGIES, INC.,

Plaintiff-Appellant,

v.

CARDINAL IG COMPANY, **Defendant-Appellee.**

No. 94-1243.

United States Court of Appeals,
Federal Circuit.

May 10, 1995.

Rehearing Denied; Suggestion for Rehearing
In Banc Declined

June 21, 1995.

Patentee brought infringement action in connection with patent for heat mirror, a coating applied to surfaces which allowed visible light to pass through but reflected heat, which was useful as window glazing material. The United States District Court for the Northern District of California, D. Lowell Jensen, J., granted summary judgment of noninfringement for defendant, and patentee appealed. The Court of Appeals, Michel, Circuit Judge, held that: (1) defendant's heat mirror did not literally infringe patent as it did not have "sputter-deposited" dielectric layer, and (2) claim of infringement under doctrine of equivalents was barred by prosecution history estoppel.

Affirmed.

Noemi C. Espinosa, Brobeck, Phleger & Harrison, of Palo Alto, CA, argued for plaintiff-appellant. With him on brief were William L. Anthony, Jr. and Douglas C. Rawles. Of counsel was Luther Kent Orton.

V. Bryan Medlock, Jr., Richards, Medlock & Andrews, of Dallas, TX, argued for defendant-appellee. With him on brief was Paul V. Storm.

Before MICHEL, LOURIE and BRYSON, Circuit Judges.

MICHEL, Circuit Judge.

Southwall Technologies, Inc. (Southwall) appeals the March 2, 1994 decision of the United States District Court for the Northern District of California, Docket No. C-92-0327-DLJ, granting summary judgment for Cardinal IG Company (Cardinal) that Cardinal's LOE² window glazing product cannot infringe Southwall's Reexamined U.S. Patent No. B1 4,799,745 (the '745 patent). Because the district court as a matter of law correctly interpreted the claims of the '745 patent to foreclose literal infringement and correctly concluded that, as limited by prosecution history, the range of permissible equivalents precluded infringement under the doctrine of equivalents, we affirm.

BACKGROUND

The invention of the '745 patent is an improved heat mirror, a thin, transparent coating applied to glass or plastic that allows visible light to pass through but reflects heat (infrared light). Such coatings are useful as

window glazing materials. A heat mirror generally comprises one or more thin layers of silver, which are transparent to visible light but reflect heat, spaced apart by a layer of dielectric material, typically metal oxide, an anti-reflective, non-absorbing material that decreases the reflection and increases the transmission of visible light. Two silver layers spaced apart by a dielectric layer form a Fabry-Perot interference filter. The heat mirror may also include additional layers of dielectric or other materials due to manufacturing constraints.

The specification of the '745 patent describes the invention as an improvement over the heat mirror of the Apfel patent, U.S. Patent No. 3,682,528. The Apfel patent teaches that to obtain thin, optically suitable layers of silver, it is necessary to first lay down a thin "nucleation" layer of nickel and then apply the silver over the nickel by vacuum deposition methods. Apfel further teaches that the silver layer may be coated with a thin layer of vapor-deposited nickel (a post-coat layer) to improve the durability of the heat mirror if another layer, such as a dielectric layer, is to be applied over the silver layer. Apfel's nucleation and post-coat layers may be a clear dielectric material such as titanium oxide rather than nickel. Because the nucleation and post-coat layers are time consuming and expensive to produce, an objective of Southwall's invention was to provide a Fabry-Perot filter with minimal complexity and production steps. The invention of the '745 patent accomplishes this objective by "employing as the interference filter a multilayer stack including at least two separate discrete continuous sputter-deposited transparent metal layers separated from

one another by discrete continuous layers of dielectric." U.S. Pat. No. 4,799,745, col. 2, lines 21-25.

Claim 14 of the reexamined[1] '745 patent, asserted by Southwall, recites (emphasis added):[2]

A visually transparent, infrared reflecting composite film comprising a transparent support having adhered to one surface thereof an interference filter having a plurality of continuous directly contiguous stacked layers, said layers comprising: a. a dielectric layer, b. [a] discrete sputter-deposited transparent metal layer, c. one or more pairs of layers, each pair comprising a dielectric spacer layer and a discrete sputter-deposited transparent metal layer, and d. a dielectric outer layer, wherein the dielectric is a sputter-deposited dielectric; the metal layers each comprise silver and each are from 4 to 17 nm in thickness and the dielectric layers each have an index of refraction of from about 1.75 to about 2.25 with the spacer layers having a thickness of from 70 to 100 nm and outer layers having a thickness of from about 30 nm to about 70 nm. In other words, claim 14 recites a support, such as glass or plastic, which is coated with "continuous

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[1] Southwall requested reexamination of the '745 patent on the ground that the Chang patent, U.S. Patent No. 4,179,181, presented a substantial new question of patentability.

[2] Claim 36 of the '745 patent, also asserted by Southwall, is identical to claim 14 except that the specified thickness of the spacer layer in the last clause is different. That difference, however, does not affect our analysis and, therefore, would not justify a different result as to infringement by the accused product.

directly contiguous stacked layers" of sputter-deposited[3] dielectric, silver, sputter-deposited dielectric, silver and, finally, sputter-deposited dielectric material. The '745 specification defines "directly contiguous" as having "its usual meaning of being in actual contact, i.e., of being adjoining." When the examiner nevertheless questioned the meaning of "directly contiguous" in a July 5, 1988 office action, Southwall replied:

The term "directly" as used in the claims is intended to mean that the layers are present or laid down contiguous with one another without intervening layers. In other words, no nucleation layers are present between two "directly contiguous" layers or between layers which are laid down "directly" on one another. In accordance with Southwall's own definition, unlike the interference filter disclosed in the Apfel patent, the interference filter recited in claim 14 can have no additional layers between the silver and the sputter-deposited dielectric layers, not even nucleation or sacrificial barrier layers.

Cardinal's LOE[2] product consists of the following layers on a glass support: zinc oxide (a dielectric), silver, titanium oxide (a dielectric), zinc oxide, silver, titanium oxide, zinc oxide, titanium dioxide and a final zinc oxide layer. The titanium oxide layer is formed by a two-step process in which titanium metal is first sputtered in a nonreactive argon atmosphere to form a layer of titanium metal covering the silver layer. The zinc oxide layer is

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[3] To deposit a thin film by sputtering, high energy particles are caused to collide with the surface of a material to dislodge atoms from that material which then deposit on the surface to be coated.

formed by a reactive sputtering process involving the sputtering of zinc metal in an oxygen atmosphere. Sputtered zinc metal reacts with the oxygen to form zinc oxide which is deposited directly onto the surface. During this process the layer of titanium metal already there is converted to titanium oxide by the action of oxygen.[4] The titanium metal layer acts as a "sacrificial barrier layer" by protecting the silver layer from oxidation during formation of the zinc oxide dielectric layer.[5] For purposes of summary judgment analysis, we assume it is completely converted to titanium oxide during this step. In sum, Cardinal's zinc oxide layer is formed by a one-step reactive sputtering process in which zinc oxide is directly deposited, whereas its titanium oxide layer is formed by a two-step process wherein the first step requires deposition of titanium metal and the second step requires oxidation of titanium metal to create titanium oxide.

Southwall filed the present suit on January 14, 1992 alleging that Cardinal's LOE[2] heat mirror infringes the '745 patent. Cardinal moved for summary judgment on the grounds that (1) its product does not infringe the '745 patent, (2) the '745 patent is invalid for failure to state the best mode of the invention, and (3) the '745 patent is invalid as either anticipated by or obvious in light of the prior art. The district court granted Cardinal's summary

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[4] The final titanium dioxide layer in Cardinal's structure is produced by the same reactive sputtering two-step process used to produce the zinc oxide layer. That layer, however, is not central to any issue in this case.

[5] Southwall protects the silver layer from oxidation during deposition of the dielectric without adding an additional layer by use of a process involving hydrogen gas.

judgment motion on the first ground but denied it on the other two. Southwall appeals the ruling that Cardinal does not infringe the '745 patent, either literally or under the doctrine of equivalents.

We have jurisdiction over this patent infringement action pursuant to 28 U.S.C. § 1295 (1988).

DISCUSSION

Summary judgment is appropriate only "if the pleadings, depositions, answers to interrogatories, and admissions on file, together with the affidavits, if any, show that there is no genuine issue as to any material fact and that the moving party is entitled to judgment as a matter of law." Fed.R.Civ.P. 56(c). The evidence must be viewed in the light most favorable to the nonmoving party. *SRI Int'l v. Matsushita Elec. Corp. of Am.*, 775 F.2d 1107, 1116, 227 USPQ 577, 581 (Fed.Cir.1985) (in banc). Regardless of the nature of the issue determined favorably to the movant, we review the district court's grant of summary judgment de novo. *International Visual Corp. v. Crown Metal Mfg. Co.*, 991 F.2d 768, 770, 26 USPQ2d 1588, 1590 (Fed.Cir.1993).

I. Literal Infringement

A literal infringement analysis requires two separate steps. First, the asserted claims must be interpreted by the court as a matter of law to determine their meaning and scope. *Markman v. Westview, Instruments Inc.*, 52 F.3d 967, 979 (Fed.Cir.1995) (in banc); *Senmed, Inc. v. Richard-Allan Med. Indus., Inc.*, 888 F.2d 815, 818, 12 USPQ2d 1508,

1511 (Fed.Cir.1989). In the second step, the trier of fact determines whether the claims as thus construed read on the accused product. *Id.*, 12 USPQ2d at 1511. To establish literal infringement, every limitation set forth in a claim must be found in an accused product, exactly. *Becton Dickinson & Co. v. C.R. Bard, Inc.*, 922 F.2d 792, 796, 17 USPQ2d 1097, 1099 (Fed.Cir.1990). Infringement, both literal and under the doctrine of equivalents, is an issue of fact. *SSIH Equip. S.A. v. United States Int'l Trade Comm'n*, 718 F.2d 365, 376, 218 USPQ 678, 688 (Fed.Cir.1983).

The parties agree that a genuine issue of fact as to whether Cardinal's product literally infringes the '745 patent exists only if Cardinal's titanium oxide and zinc oxide layers together form "a sputter-deposited dielectric" layer. Because Cardinal does not dispute that the zinc oxide is "a sputter-deposited dielectric," the key issue here becomes whether the titanium oxide covering the silver can also be described as "sputter-deposited" as that phrase is used in claim 14 and elsewhere defined in the '745 patent. If Cardinal's titanium oxide layer, which is "directly contiguous" with the silver layer, is not "sputter-deposited," the Cardinal product lacks the limitation of claim 14 that the dielectric layer "directly contiguous" with the silver layer be "sputter-deposited" and Cardinal's product cannot literally infringe the '745 patent.

A. The District Court's Claim Construction

The district court looked to the prosecution history of the '745 patent to interpret the claim term "sputter-deposited dielectric." The district court concluded the

prosecution history requires that a "sputter-deposited dielectric" be formed by a one-step reactive sputtering process and specifically not by a two-step process in which a metal layer is first deposited and then later oxidized.[6] Because Cardinal's titanium oxide layer is formed by a two-step process in which the titanium is first deposited as a metal layer and then later oxidized, the district court concluded Cardinal's titanium oxide layer could not be a "sputter-deposited dielectric." Because Cardinal's product does not have a "sputter-deposited dielectric" layer "directly contiguous" with the silver layer, the district court further held that, as a matter of law, Cardinal's product could not literally infringe the '745 patent.

We agree with this analysis. Arguments and amendments made during the prosecution of a patent application and other aspects of the prosecution history, as well as the specification and other claims, must be examined to determine the meaning of terms in the claims. *E.I. du Pont de Nemours & Co. v. Phillips Petroleum Co.*, 849 F.2d 1430, 1438, 7 USPQ2d 1129, 1135 (Fed.Cir.), *cert. denied*, 488 U.S. 986, 109 S.Ct. 542, 102 L.Ed.2d 572 (1988). The

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[6] Although the district court erred in assuming that the entirety of Cardinal's dielectric layer, rather than only the titanium oxide layer, was formed by a two-step process, this error did not undermine the court's analysis because claim 14 requires that the "sputter-deposited dielectric" layer be "directly contiguous" with the silver layer. Thus, if the titanium oxide layer, which is "directly contiguous" with the silver layer, cannot be described as a "sputter-deposited dielectric," Cardinal cannot literally infringe that claim even though its zinc oxide layer can be described in this manner.

prosecution history limits the interpretation of claim terms so as to exclude any interpretation that was disclaimed during prosecution. *ZMI Corp. v. Cardiac Resuscitator Corp.*, 844 F.2d 1576, 1580, 6 USPQ2d 1557, 1561 (Fed.Cir.1988); *Senmed, Inc.*, 888 F.2d at 818-20, 12 USPQ2d at 1511-13 (rejecting patentee's interpretation of claim term "on" as inconsistent with position taken during prosecution of patent application). Claims may not be construed one way in order to obtain their allowance and in a different way against accused infringers. *Unique Concepts, Inc. v. Brown*, 939 F.2d 1558, 1562, 19 USPQ2d 1500, 1504 (Fed.Cir.1991).

In the office action, dated July 5, 1988, the examiner made only one rejection based on prior art, rejecting all the pending claims as anticipated by, or alternatively, as obvious in view of Franz, U.S. Patent No. 3,846,152: Franz teaches employing alternate layers of metal/metal oxide to a transparent substrate such as glass or plastic and the use of a protective layer to make a transparent heat reflecting window. . . . The metal layer is sputter deposited and the metal oxide layer is sputter deposited as a metal and then oxidized, see col. 4, lines 25-28. It is unclear whether the "metal oxide is sputter-deposited" limitation is meant to encompass the situation where the metal oxide is [s]putter deposited as a metal and later oxidized. Until clarification the examiner most [sic, must] interpret the claims broadly.

In response, Southwall amended an independent claim to describe the dielectric as a "sputter-deposited

inorganic metal oxide, compound or salt."[7] Southwall explained the amendment:

> It is believed that the claims as last presented distinguished patentably over the Franz and Yatabe disclosure[s] but to provide yet additional clear bases for distinction the claims have been amended to specify that the dielectric layer is laid down as a sputter-deposited inorganic metal oxide, compound or salt[.] As pointed out in the specification such layers can be laid down directly by reactive sputtering processes in which the metal is sputtered off of a metal target and directly converted to the oxide, compound or salt by the presence of a suitable gaseous reactant.

(Emphasis added.) In this response Southwall necessarily disclaimed the examiner's interpretation of "sputter-deposited" metal oxides as encompassing a two-step process in which metal is first deposited as a metal and then oxidized. In contrast to the examiner's interpretation in his office action being responded to, Southwall

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[7] Earlier versions of some original '745 claims had also used the narrower limitation "inorganic metal oxide, compound or salt" rather than "dielectric," which was used later. Although Southwall attempts to make much of this difference, it does not affect our analysis because in both instances the key phrase the meaning of which is at issue, "sputter-deposited," is used in exactly the same manner, to modify the general class of dielectric materials as the list of specific dielectric materials. The arguments regarding the "sputter-deposited inorganic oxide, compound or salt" made during prosecution are thus relevant to our interpretation of "sputter-deposited dielectric" for purposes of literal infringement as well as to the application of prosecution history estoppel to limit the range of equivalents accorded that term.

explained that its sputter-deposited dielectric is laid down in a one-step reactive sputtering process. Thus, the prosecution history limits the interpretation of "sputter-deposited dielectric" layer to exclude any dielectric layer formed by the two-step process. Because Cardinal's titanium oxide layer is formed in this manner it cannot be a "sputter-deposited dielectric."

Southwall argues, however, that Cardinal's two-step process is an indirect method of forming a "sputter-deposited dielectric," but is still a sputter-deposition process because Cardinal's titanium dioxide layer exists only by virtue of sputter-deposition. The titanium metal is sputter-deposited and converted to the oxide during sputter-deposition of zinc oxide. According to Southwall, the statement in the prosecution history, "such layers can be laid down directly" implies that the layers can also be laid down indirectly. However, Cardinal's titanium oxide layer is not laid down by sputter deposition as defined in the '745 patent, only the titanium metal layer is. The titanium oxide is formed by treating deposited titanium metal with oxygen. Although this occurs while a different material, zinc oxide, is being sputter-deposited, the reason for the presence of the oxygen does not change the post-deposition oxidation process by which the titanium oxide is formed and does not convert that process into a sputter deposition, i.e., a one-step process.

Because we conclude that a "sputter-deposited dielectric," as that term is used in claim 14, cannot be formed by a two-step process in which a metal layer is first sputter-deposited and then oxidized, we can only conclude that Cardinal's product does not have a "sputter-deposited dielectric" layer "directly contiguous" with

the silver layer. Therefore, like the district court, we hold that as a matter of law Cardinal's product cannot literally infringe the '745 patent.

B. Southwall's Arguments

Southwall argues that "sputter-deposited dielectric" must be interpreted to also include a dielectric layer formed by the two-step deposition process oxidizing it because Southwall presented evidence that persons of ordinary skill in the art construe the expression to include any dielectric that results from materials laid down by sputtering. Southwall's evidence is affidavit testimony by its two experts describing Cardinal's titanium oxide layer as a "sputter-deposited dielectric." Alternatively, Southwall argues that any conflict between its experts and the prosecution history as to the meaning of "sputter-deposited dielectric" creates a genuine fact issue which makes summary judgment inappropriate.

Southwall imposes a contorted and incorrect analytical framework on the issues of claim interpretation and literal infringement when it argues: 2. The uncontroverted testimony of the experts below establishes that those skilled in the art consider a dielectric layer formed either by reactive sputter-deposition or by sputter up-oxidation [the two-step process] of a sacrificial layer to constitute a "sputter-deposited dielectric." Thus, the term "sputter-deposited dielectric" is literally met by the accused Cardinal structure; 3. Therefore, since the claim as written literally describes the Cardinal structure, the arguments made with respect to that term in the file history must be reviewed to determine whether that

expression was given a special meaning in Southwall's arguments which excludes the Cardinal structure. If the phrase was accorded a special meaning in the file history, a determination must be made as to whether the file history should be used merely to "interpret" the claims, or whether a file history estoppel by argument exists as to one or more of the claims. Appellant's Brief at 35.

Southwall's framework fails in several respects. First, the evidence offered by Southwall does not establish the ordinary meaning of "sputtered-deposited dielectric" to one skilled in the art. In his declaration Dr. Stephen F. Meyer merely stated "it seems to me that [Cardinal's] dielectric layer as a whole (including both the titanium dioxide [sic, oxide] and the zinc oxide) could quite fairly be characterized as a 'sputter-deposited dielectric'." Similarly, Robert L. Cormia's declaration states, "it is my opinion that the 'titanium' barrier layer that Cardinal deposits immediately after each of the silver layers is a 'sputter-deposited dielectric' in the LOE² coatings, as that phrase is used in the '745 Patent." Neither Meyer nor Cormia testified as to how one skilled in the art would interpret the term "sputter-deposited" when viewed in light of the claims, specification and prosecution history. This testimony provides only conclusory legal opinions as to whether Cardinal's titanium oxide is a "sputter-deposited dielectric" rather than evidence of how that term is commonly used and understood in the art. *See Becton Dickinson & Co.*, 922 F.2d at 797, 17 USPQ2d at 1100 (affidavit of expert on what constitutes an "extension" in the context of the asserted claim was only legal opinion which did not create a material fact issue).

Second, Southwall assumes that a claim term is only interpreted by first looking to its meaning in the art and then limiting that meaning in accordance with any relevant prosecution history, by either interpretation or prosecution history estoppel. The terms in a claim, however, are not given their ordinary meaning to one of skill in the art when it appears from the patent and file history that the terms were used differently by the applicant. *Intellicall, Inc. v. Phonometrics, Inc.*, 952 F.2d 1384, 1387, 21 USPQ2d 1383, 1386 (Fed.Cir.1992). A patentee may not proffer an interpretation for the purposes of litigation that would alter the indisputable public record consisting of the claims, the specification and the prosecution history, and treat the claims as a "nose of wax." *Senmed, Inc.*, 888 F.2d at 819 n. 8, 12 USPQ2d at 1512 n. 8. In other words, evidence extrinsic to the patent and prosecution history, such as expert testimony, cannot be relied on to change the meaning of the claims when that meaning is made clear by those documents.

Because the meaning of "sputter-deposited dielectric" as used in claim 14 is clear from the prosecution history of the '745 patent, Southwall's expert affidavits cannot alter that meaning. Even if Southwall could show that "sputter-deposited dielectric" has a meaning to one skilled in the art different from the definition in the '745 specification and file history, the definition in the patent documents controls the claim interpretation. *See Markman*, 52 F.3d at 981. Thus, we may not consider Southwall's opinion expert testimony as we interpret claim 14 as a matter of law. Because the expert testimony is entitled to no weight, it cannot create a genuine issue of material fact precluding summary judgment. Claim

interpretation, as a question of pure law, is amenable to summary judgment and disagreement over the meaning of a term within a claim does not necessarily create a genuine issue of material fact. *See id.* at 979; *Intellicall, Inc.*, 952 F.2d at 1387, 21 USPQ2d at 1386. Any other rule would be unfair to competitors who must be able to rely on the patent documents themselves, without consideration of expert opinion that then does not even exist, in ascertaining the scope of a patentee's right to exclude.

Third, Southwall seems to imply that principles of prosecution history estoppel are relevant in the claim construction step of a determination of literal infringement. There is, however, a clear distinction between following the statements in the prosecution history in defining a claim term, and the doctrine of prosecution history estoppel, which limits expansion of the protection under the doctrine of equivalents when a claim has been distinguished over relevant prior art. *Biodex Corp. v. Loredan Biomedical, Inc.*, 946 F.2d 850, 862, 20 USPQ2d 1252, 1262 (Fed.Cir.1991), *cert. denied*, 504 U.S. 980, 112 S.Ct. 2957, 119 L.Ed.2d 579 (1992). Claim interpretation in view of the prosecution history is a preliminary step in determining literal infringement, while prosecution history estoppel applies as a limitation on the range of equivalents if, after the claims have been properly interpreted, no literal infringement has been found. *See Senmed, Inc.*, 888 F.2d at 818-21, 12 USPQ2d at 1511-13. The limit on the range of equivalents that may be accorded a claim due to prosecution history estoppel is simply irrelevant to the interpretation of those claims.

Southwall further argues that the district court erred by failing "to recognize that in some claim combinations,

the two-step process would not be literally covered by the claims, while in other claim combinations, the claim may be patentable for other reasons and literally cover a two-step dielectric process." Appellant's Brief at 44. Southwall then presents extended discussion tracing the development of claim 14 from the application through the prosecution to show that the cited arguments it made during prosecution did not apply to any earlier version of claim 14.

Whether claim 14 derived from any application claim discussed in the prosecution history is irrelevant to our interpretation of claim 14 in light of that history. "Sputter-deposited dielectric" cannot be interpreted differently in different claims because claim terms must be interpreted consistently. *See Fonar Corp. v. Johnson & Johnson*, 821 F.2d 627, 632, 3 USPQ2d 1109, 1113 (Fed.Cir.1987), *cert. denied*, 484 U.S. 1027, 108 S.Ct. 751, 98 L.Ed.2d 764 (1988). Interpretation of a disputed claim term requires reference not only to the specification and prosecution history, but also to other claims. *Id.* at 631, 3 USPQ2d at 1112. The fact that we must look to other claims using the same term when interpreting a term in an asserted claim mandates that the term be interpreted consistently in all claims. *Id.* at 632, 3 USPQ2d at 1113 (examining use of term "standard" in nonasserted claims to interpret same term in asserted claims). Accordingly, arguments made during prosecution regarding the meaning of a claim term are relevant to the interpretation of that term in every claim of the patent absent a clear indication to the contrary.

II. Infringement Under The Doctrine of Equivalents

An accused product that does not literally infringe a claim may infringe under the doctrine of equivalents if "it performs substantially the same function in substantially the same way to obtain the same result." *Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*, 339 U.S. 605, 608, 70 S.Ct. 854, 856, 94 L.Ed. 1097, 85 USPQ 328, 330 (1950). Only if an accused product contains specific structure which meets all limitations of an asserted claim directed to structure, at least equivalently, can that product infringe under the doctrine of equivalents. *Pennwalt Corp. v. Durand-Wayland, Inc.*, 833 F.2d 931, 935, 4 USPQ2d 1737, 1739 (Fed.Cir.1987) (in banc), *cert. denied*, 485 U.S. 961, 108 S.Ct. 1226, 99 L.Ed.2d 426 (1988). The doctrine of equivalents, however, is not a tool for expanding the protection of a patent after examination has been completed. *Hormone Research Foundation, Inc. v. Genentech, Inc.*, 904 F.2d 1558, 1564, 15 USPQ2d 1039, 1044 (Fed.Cir.1990). Thus, prosecution history estoppel limits the range of equivalents available to a patentee by preventing recapture of subject matter surrendered during prosecution of the patent. *Townsend Eng'g Co. v. HiTec Co.*, 829 F.2d 1086, 1090, 4 USPQ2d 1136, 1139 (Fed.Cir.1987). The application of prosecution history estoppel raises a question of law which we review de novo. *LaBounty Mfg., Inc. v. United States Int'l Trade Comm'n*, 867 F.2d 1572, 1576, 9 USPQ2d 1995, 1998 (Fed.Cir.1989).

The issue presented by this appeal is whether, because of the manner of its manufacture, Cardinal's titanium oxide layer is excluded, as a matter of law, from

the range of equivalents that can be accorded the limitation "sputter-deposited dielectric."[8] The district court applied prosecution history estoppel in holding that the range of equivalents could not extend to Cardinal's dielectric layer because, "[t]he Examiner specifically rejected any process where the 'metal oxide is [s]putter-deposited as a metal and later oxidized.' The Cardinal process is such a process." Slip op. at 20. Having concluded that the range of equivalents accorded this limitation in claim 14 could not encompass Cardinal's titanium oxide layer, the district court correctly held that as a matter of law Cardinal's product could not infringe the '745 patent under the doctrine of equivalents.

A. Estoppel Extends Beyond the Embodiments Shown in Franz

Southwall contends that the district court erred by limiting the range of equivalents beyond what it necessarily surrendered during prosecution to distinguish its claims over the Franz patent. According to Southwall, it

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[8] Cardinal does not contest for purposes of this appeal that "but for" the titanium oxide sacrificial barrier layer, factual issues exist as to whether its product infringes claim 14 under the doctrine of equivalents. Because claim 14 recites a "sputter-deposited dielectric" layer which is "directly contiguous" with a silver layer, additional layers in Cardinal's product intervening between its own "sputter-deposited dielectric" and silver layers would prevent infringement because a limitation would be entirely lacking from the accused device. Southwall suggests no way in which Cardinal's product can satisfy the "directly contiguous" limitation, even equivalently, if the titanium oxide layer is not a "sputter-deposited dielectric."

surrendered only the embodiments shown in Franz. To form metal oxide layers, Franz deposits a metal layer and then heats the device in the presence of oxygen. However, Franz also teaches that the uniformity of oxidation may be enhanced by first treating the metallic surface to be oxidized with a surfactant. Southwall argues that only an oxidation process including treatment with a surfactant like Franz's oxidation step, and not the two-step process used by Cardinal, is excluded from the range of equivalents that can be accorded the term "sputter-deposited" because the pertinent prosecution arguments were made only to distinguish Franz, not every two-step process. Southwall asserts that there is a permissible range of equivalents between the wet chemical oxidation process of Franz and the "sputter-deposited dielectric" laid down by reactive (one-step) sputtering and, therefore, it is entitled to have the trier of fact determine whether Cardinal's titanium oxide layer falls within that permissible range of equivalents, making summary judgment inappropriate.

When a court applies the doctrine of prosecution history estoppel to limit the scope of equivalents, "a close examination must be made as to, not only what was surrendered, but also the reason for such a surrender." *Hi-Life Prods., Inc. v. American Nat'l Water-Mattress Corp.*, 842 F.2d 323, 325, 6 USPQ2d 1132, 1134 (Fed.Cir.1988) (quoting *Bayer Aktiengesellschaft v. Duphar Int'l Research B.V.*, 738 F.2d 1237, 1243, 222 USPQ 649, 653 (Fed.Cir.1984). Here, the surrender was quite deliberate and express. It can hardly be termed inadequate or ambiguous. Moreover, because the pertinent differences between the Franz process and the Cardinal process are

trivial, the reasons for a surrender of the subject matter of the Franz process would necessarily include a surrender of Cardinal's process. Both processes first involve deposition of a metal layer followed by the heating of that layer in an oxygen atmosphere. In addition, Franz teaches that the uniformity of the resulting metal oxide film can be enhanced by treating the metal layer with a surfactant prior to oxidation. The fact that the surfactant treatment is taught as an optional enhancement to the Franz process, necessarily contemplates that the metal oxide can be formed without this step. Consequently, in distinguishing Franz, Southwall necessarily surrendered all two-step processes for forming the metal oxide layer, both those with and those without the surfactant treatment. Neither does the fact that Franz subjects its metal layer to an oxygen atmosphere in a separate step whereas Cardinal subjects the titanium layer to oxygen during the subsequent step of sputter-deposition of zinc oxide provide a meaningful distinction. The important factor is the presence of oxygen, regardless of the reason for that presence.

An important feature of Southwall's invention is the ability to reactively sputter a dielectric layer directly contiguous with a silver layer without oxidizing the silver layer. Southwall's process allows formation of a dielectric layer in one step, avoiding the need for barrier layers intervening between the reactively sputtered dielectric and silver layers to protect the silver from oxidation. Such barrier layers complicated the manufacturing process and increased costs. As shown by Franz, a process in which a metal layer is first deposited over a silver layer and then oxidized was known. In distinguishing Franz during prosecution, Southwall chose not to rely on the

exact method by which Franz formed his dielectric layer over silver but specifically relied on the fact that Franz showed a multistep process for doing so, whereas Southwall claimed a dielectric layer formed by a one-step process. Thus, an examination of both the nature of and the reason for Southwall's disclaimer of the Franz process demonstrates that Southwall surrendered all "two-step" processes for forming a dielectric contiguous with silver, which would include Cardinal's two-step process of forming titanium oxide, regardless of the precise steps of the process.

An August 18, 1988 response to an office action, in which Southwall distinguished Franz according to the manner in which Franz formed the dielectric layer, further confirms this point: To further emphasize the distinctions between the present invention and the Franz reference, it should be noted that Franz obtains his metal oxide layers by depositing a metal layer and then chemically converting it to the desired oxide. In this and the earlier cited statements, Southwall surrendered the Cardinal process which can be described in a manner identical with this statement. Having distinguished the Franz patent on the basis that "Franz obtains his metal oxide layers by depositing a metal layer and then chemically converting it to the desired oxide," whereas Southwall forms its dielectric layer by "reactive sputtering processes in which the metal is sputtered off of a metal target and directly converted to the oxide," Southwall cannot now escape Cardinal's reliance upon this unambiguous surrender of subject matter. *See Lemelson v. General Mills, Inc.*, 968 F.2d 1202, 1208, 23 USPQ2d 1284, 1289 (Fed.Cir.1992) ("Other players in the marketplace are entitled to rely on

the record made in the Patent Office in determining the meaning and scope of the patent.")

In addition, we previously rejected the very argument made by Southwall, that prosecution history estoppel is limited only to embodiments shown in the prior art, in *Wang Labs., Inc. v. Toshiba Corp.*, 993 F.2d 858, 26 USPQ2d 1767 (Fed.Cir.1993). Wang's claims recited memory chips mounted "in a single row." The accused infringers produced a device having memory chips mounted in two rows, which feature Wang argued was equivalent to the "single row" limitation. *Id.* at 866, 26 USPQ2d at 1775. Wang contended that the prosecution history did not exclude a substrate having memory chips mounted in two rows because the two row construction did not read on the prior art. *Id.* at 867-68, 26 USPQ2d at 1775-76. However, because Wang limited the scope of its claims to memory chips mounted "only in a single row" and twice argued before the PTO that its claims were distinguished over the prior art on the basis of this limitation, we held that Wang surrendered the two row construction during prosecution. *Id.* at 868, 26 USPQ2d at 1776. As demonstrated by the facts in Wang, the limits imposed by prosecution history estoppel on the permissible range of equivalents can be broader than those imposed by the prior art. *Haynes Int'l, Inc. v. Jessop Steel Co.*, 8 F.3d 1573, 1579, 28 USPQ2d 1652, 1657 (Fed.Cir.1993), *clarified, reh'g granted*, 15 F.3d 1076, 29 USPQ2d 1958 (Fed.Cir.1994). Such is the case here.

For these reasons, we hold that the prosecution history limits the range of equivalents that can be accorded

the term "sputtered-deposited dielectric" to exclude Cardinal's titanium oxide layer and, therefore, as a matter of law, Cardinal cannot infringe the '745 patent under the doctrine of equivalents.

B. The Prosecution History Supports the Separate Estoppel Regarding the Manner of Forming the Dielectric

Southwall further argues that the district court erred by disregarding the holding of *Read Corp. v. Portec, Inc.*, 970 F.2d 816, 23 USPQ2d 1426 (Fed.Cir.1992). Southwall cites *Read* for the proposition that separate statements made by a patentee to distinguish a prior art reference can never create separate estoppels. Under Southwall's theory, where a patent applicant sets forth multiple bases to distinguish between its invention and the cited prior art, no estoppel by argument can attach to the patent claims unless all of the bases taken together also distinguish the accused device from the asserted claims. In other words, unless the accused device contains all the features of the prior art used in distinguishing the asserted claims, estoppel cannot apply.

During prosecution Southwall distinguished the Franz patent on two bases: 1) that Franz taught a metal oxide layer formed by a two-step process rather than a one-step process, and 2) that Franz taught a filter using only one metal layer and one nonmetal layer rather than "a filter in which two metal layers and a dielectric layer interact to give rise to the filtering properties" as recited

in the claims.[9] Under Southwall's interpretation of *Read*, Southwall only surrendered the two-step process of forming a dielectric when such a process is applied to a filter having a single metal layer. Southwall argues that for Cardinal to be entitled to an estoppel based on Southwall's arguments distinguishing the Franz patent according to dielectric formation, the other distinction over the Franz patent made during prosecution must also apply to Cardinal's product. Therefore, Southwall maintains that the range of equivalents accorded "sputter-deposited dielectric" is not limited in this case unless Cardinal's product has, like Franz's device, only a single metal layer (which clearly it does not).

Southwall's interpretation expands *Read* beyond its facts and rationale. Indeed, it inverts the holding of *Read*. There, we held multiple arguments do not always create multiple estoppels. Southwall, however, argues that *Read* holds multiple arguments never create multiple estoppels. The correct law, as *Read* implies, is that sometimes they do, sometimes they do not.

Read's asserted claim was directed to a relatively simple mechanical device, a portable loam screening apparatus for separating fine earth material from coarser materials. After the examiner rejected the claims under 35 U.S.C. § 103 as obvious in view of various combinations

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[9] Southwall attempts to deconstruct this latter distinction into seven separate bases for distinguishing its invention from the Franz patent. Appellant's Brief at 40-41. In the prosecution history Southwall provides multiple arguments to demonstrate that Franz does not teach a Fabry-Perot interference filter but these arguments support only one distinction.

of references, *Read* added a limitation reciting: a set of wheels mounted to one of said sides [of the apparatus frame] and movable relative to said frame from an operative position for transporting said apparatus to an inoperative position for resting said frame flush on the ground. *Id.* at 819, 23 USPQ2d at 1429. The prosecution history showed that the examiner found this amendment insufficient for patentability but agreed to allow the claims if further amended to include limitations indicating the relationship of the tall end of the apparatus frame to the payloader and where the short end of the frame's "closed" characteristics began and ended. The claim was amended to describe these characteristics[10] and allowed on that basis. *Id.*, 23 USPQ2d at 1429.

The accused infringer, Portec, argued that *Read* was estopped by the prosecution history from asserting any range of equivalents for the limitation pertaining to the retractable wheels because *Read* had pointed out during prosecution that some references did not have this feature. *Id.* at 824, 23 USPQ2d at 1433. In rejecting Portec's contention we explained: Every statement made by a patentee during prosecution to distinguish a prior art reference does not create a separate estoppel. Arguments must be viewed in context. In context, *Read* distinguished, for example, the Deister reference because of a wealth of

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[10] The asserted claim recited the limitation as follows: a frame of generally rectangular cross section and having a tall end and a short end joint [sic] by sides, said short end being closed from an upper edge of said short end to the ground and the lower portion of said tall end being completely open from the ground to a height sufficiently high to permit a payloader to collect the finer material from within the frame.

differences. . . . *Read* pointed out differences not only respecting the wheels . . . but also marked differences in other parts of the structure. Thus, any estoppel created by Portec's [sic, Read's] argument encompasses all of these combined distinctions of Deister and not an estoppel respecting each of the individual differences, e.g., that any device with non-movable wheels cannot infringe. *Id.*, 23 USPQ2d at 1433 (emphasis in original).

Read does not hold, as Southwall asserts, that arguments made during prosecution can only create an estoppel regarding the combined distinctions and can never create separate estoppels. Rather, the prosecution history must be examined as a whole in determining whether, based on a particular argument, a particular estoppel applies. *See Texas Instruments, Inc. v. United States Int'l Trade Comm'n*, 988 F.2d 1165, 1173, 26 USPQ2d 1018, 1025 (Fed.Cir.1993). For instance, any argument made regarding the need to distinguish the prior art, in *Read* the characteristics of the frame, does create a separate estoppel, regardless of other distinctions made. *See Vaupel Textilmaschinen KG v. Meccanica Euro Italia S.P.A.*, 944 F.2d 870, 882, 20 USPQ2d 1045, 1054 (Fed.Cir.1991) ("The doctrine of prosecution history estoppel bars 'a patentee from enforcing its claims against otherwise legally equivalent structures if those structures were excluded by claim limitations added in order to avoid prior art.' " (citation omitted)).

Estoppel extends beyond the basis of patentability, however. Clear assertions made during prosecution in support of patentability, whether or not actually required to secure allowance of the claim, may also create an estoppel. *Texas Instruments, Inc.*, 988 F.2d at 1174, 26

USPQ2d at 1025. In *Read*, the patentee argued for patentability based on a combination of elements including retractable wheels because cited prior art disclosed retractable wheels. The patentee recognized that the wheels alone were insufficient to establish patentability. *Read*, 970 F.2d at 824, 23 USPQ2d at 1433. Because *Read* argued that patentability was established by its combination of known elements, it created an estoppel only regarding the combined distinctions. It is important to note, moreover, that we concluded that the argument created an estoppel regarding the combination even though the examiner did not allow the claims based on the combination and the associated argument. The claims were still rejected after *Read* had added the limitation pertaining to the wheels and made the relevant arguments regarding the wheels combined with other elements. Thus, we must examine the character of assertions made in the prosecution history in addition to the result of those assertions, i.e., whether they result in allowance, when determining whether they create an estoppel.

In the instant case, Southwall did not argue for allowance based on the combination of a "sputter-deposited" metal oxide layer with an interference filter having two metal layers. Because the Franz patent disclosed neither limitation, Cardinal could have reasonably assumed that either one alone could have provided the basis for patentability. Therefore, the rationale of Read applying estoppel to only a combination is not relevant to this case. Accordingly, we may examine Southwall's prosecution argument distinguishing its "sputter-deposited" metal oxide from Franz's separately from Southwall's other arguments distinguishing Franz. When we do, we

conclude the separate arguments create separate estoppels.

C. The Arguments Made to Distinguish Franz Limit All Claims Using the Terms Defined in Those Arguments

Southwall argues that the arguments made during prosecution regarding the amended claim term "sputter-deposited metal oxide, compound or salt" do not create an estoppel limiting the range of equivalents that can be accorded claim 14 because they were not made about that claim or the pertinent phrase, "sputter-deposited dielectric." According to Southwall, no equivalents of "sputter-deposited dielectric" were surrendered by these arguments. In Southwall's view, since the arguments concerning Franz were never made to obtain allowance of the claims now being asserted, claims 14 and 36, but instead were directed to now canceled claims in the application, there is no estoppel. Southwall cites no authority explicitly so holding.

Southwall's analysis contains several flaws. First, whether the material of the layer was described as a "metal oxide, compound or salt" or as a "dielectric" was irrelevant to the arguments Southwall made. They centered on its definition of "sputter-deposited" as describing a one-step reactive sputtering process rather than a two-step process. Therefore, we conclude that this substitution of phraseology did not affect the subject matter surrendered by Southwall in distinguishing the Franz reference.

Secondly, as explained above, the actual basis for patentability is not the only factor that determines whether an argument in the prosecution history creates an estoppel. We look also to the context and character of the argument.

And once an argument is made regarding a claim term so as to create an estoppel, the estoppel will apply to that term in other claims. *See Texas Instruments Inc.*, 988 F.2d at 1175, 26 USPQ2d at 1026 ("The prosecution history estoppel we hold proven on claim 12 is equally applicable to claims 14 and 17."). If the arguments made with respect to one claim limit the range of equivalents accorded a term in that claim and that term is later incorporated into another claim, the range of equivalents accorded the other claim must be limited in the same manner. Competitors must be able to rely on the definition of a claim term given in the prosecution history, even when the term is later incorporated into different claims, in order to understand what constitutes infringement. Given the metamorphosis that claims often go through during prosecution, it is often impossible to trace the lineage of the finally allowed claims to decide which arguments pertained to which claims. Therefore, that Southwall might have made the arguments distinguishing Franz with regard to versions of the claims not now at issue does not avoid those arguments limiting later or different versions of the claims.

Southwall relies on *Wilson Sporting Goods Co. v. David Geoffrey & Assocs.*, 904 F.2d 677, 14 USPQ2d 1942 (Fed.Cir.), *cert. denied*, 498 U.S. 992, 111 S.Ct. 537, 112 L.Ed.2d 547 (1990), for support of its argument that a

term may have a different range of equivalents in different claims. Southwall misreads *Wilson* which merely states that the range of equivalents accorded a broader, independent claim may be narrower than the range of equivalents accorded a dependent claim in order to prevent the broader claim from encroaching on prior art which the additional limitations of the dependent claims avoid. 904 F.2d at 686, 14 USPQ2d at 1949. *Wilson* does not address prosecution history. Further, in contrast to *Wilson*, the issue before us is not the range of equivalents which, if analyzed as hypothetical claims, would be patentable in light of the prior art, but what otherwise equivalent subject matter Southwall surrendered in the arguments made to the examiner.

We have considered Southwall's other arguments on appeal and find them unpersuasive and separate discussion of them is unwarranted.

CONCLUSION

Because as a matter of law Cardinal's product does not contain a "sputter-deposited dielectric" layer "directly contiguous" with a silver layer, even equivalently, the district court's grant of summary judgment for Cardinal was not in error. In accordance with the prosecution history, we interpret "sputter-deposited dielectric" to encompass only a dielectric layer formed by a one-step reactive sputtering technique. Moreover, Southwall is estopped by the prosecution history from asserting a range of equivalents for the limitation "sputter-deposited dielectric" that includes a dielectric formed by a two-step process. Because Cardinal's titanium oxide

layer, which is directly contiguous with its silver layer, is formed by a two-step process, the titanium oxide is neither literally a "sputter-deposited dielectric" nor an equivalent of that limitation. As such, Cardinal's device lacks the limitation of claim 14 requiring a "sputter-deposited dielectric" "directly contiguous" with a silver layer and, therefore, as a matter of law Cardinal cannot infringe the '745 patent. Accordingly, summary judgment of non-infringement was proper.

AFFIRMED.

Not Reported in F.Supp.
(Cite as: 1994 WL 118008 (N.D.Cal.))

SOUTHWALL TECHNOLOGIES, INC., Plaintiff,

v.

CARDINAL IG COMPANY, Defendant.

No. C-92-0327-DLJ.

United States District Court, N.D. California.
March 2, 1994.

JENSEN, District Judge.

On June 9, 1993, the Court heard arguments on defendant Cardinal's motion for summary judgment. William L. Anthony, Noemi C. Espinosa and Douglas C. Rawles appeared on behalf of plaintiff Southwall Technologies. Paul V. Storm and V. Bryan Medlock, Jr. of Richards, Medlock & Andrews and Mary B. Cranston of Pillsbury Madison & Sutro appeared on behalf of defendant Cardinal. At the request of the Court, supplemental briefs were submitted by the parties on November 12, 1993. Having considered the arguments of counsel and the papers submitted, the Court hereby GRANTS in part and DENIES in part Cardinal's motion for summary judgment.

BACKGROUND

This is a patent infringement suit involving "heat mirrors." A heat mirror is a thin, transparent coating applied to glass or plastic that allows visible light to pass

through and reflects heat (or infrared light) away. Plaintiff Southwall Technologies is in the business of designing, manufacturing and selling heat mirrors. It owns the rights to the patent at issue in this case. Defendant Cardinal IG Company is a competitor of Southwall in the same industry. Southwall has sued Cardinal for infringement of its patent issued in Reexamination Certificate B1 4,799,745 ('745).

Cardinal brings this summary judgment motion arguing (1) Cardinal's product does not infringe the '745 patent, (2) the '745 patent is invalid for failure to disclose the best mode of the invention, (3) the '745 patent is invalid because it is anticipated by a prior publication, and (4) the '745 patent is invalid because it is obvious in light of the prior art.

The basic idea behind heat mirrors is to allow visible light to pass through glass or plastic while reflecting or blocking out heat. This is achieved by applying thin coatings of various substances to a transparent surface. Depending on its reflective constant, a substance will reflect or transmit light of different wavelengths differently. Visible light has a wavelength of 380-750 nanometers, while infrared energy (or heat) has a wavelength greater than 750 nanometers. Silver is a useful metal to use in heat mirrors as it is substantially transparent to light in the visible wavelength range and highly reflective of light in the infrared wavelength range.

Heat mirrors usually employ one or two layers of silver. When two silver layers are used, they are normally spaced apart with a layer of another material between them. This sandwich-like configuration for silver heat

mirrors is called an interference filter or a Fabry-Perot filter. The middle layer consists of an anti-reflective, non-absorbing material, usually a dielectric, which decreases the reflection and increases the transmission of visible light. A "dielectric" is generally understood to be a metal oxide. Fabry-Perot filters usually consist of five layers coated on top of glass: a dielectric, silver, a dielectric, silver, and a dielectric.

In 1972 the Apfel patent was issued for a heat mirror in which the layers of Apfel coating were formed by a process known as evaporative vacuum deposition. One of the drawbacks of applying the coating by evaporative vacuum deposition was that the silver tended to "puddle" on the surface to which it was applied during the early stages of deposition. The silver would eventually form a continuous layer when the puddles became large enough to merge together, but if this process did not occur quickly, the layer of silver would become too thick and the amount of visible light transmitted would be reduced.

The Apfel patent solved the puddling problem by depositing an initial "nucleation" layer before depositing the silver layer, which helped the silver more easily and quickly form a continuous layer during deposition. In addition, Apfel disclosed that a post-coat of the same or similar "nucleation" material may be applied on top of the silver to improve the durability of the product. Thus, the Apfel invention consisted of the glass, a dielectric layer, nickel, silver, nickel, another dielectric layer, nickel, silver, nickel, and a final dielectric layer. Southwall distinguishes the "nucleation layer" which is deposited

under the silver layer (the elimination of which Southwall promoted as an advantage to its invention) from the "sacrificial 'barrier' layer" which is deposited over the silver layer (to protect the silver from oxidization).

Southwall constructs a heat mirror with two layers of silver, which it manufactures by a process known as magnetron sputter deposition, in which a cathode sputter deposition process enhanced by the use of a DC magnetron is used. In manufacturing heat mirror coatings by DC sputter deposition a problem arises when the dielectric on top of the silver is formed by sputter depositing the dielectric. The problem is that when the dielectric is formed by adding a metal, like zinc, to an oxide to form zinc oxide, the oxide also reacts with the silver to form silver oxide. Thus, a protective layer is needed between the silver and the dielectric. The Apfel patent applied an additional layer of nickel to solve this problem. The addition of an extra layer, however, added to the cost of manufacturing and decreased the reflection of heat and transmission of visible light. Southwall's solution was to use a process involving hydrogen gas, which protected the silver from oxidation during the coating of the dielectric without adding an additional layer. Southwall obtained the '745 patent for its invention on January 24, 1989, which claimed as its major contribution the elimination of the protective layer on top of the silver.

Claim 14 of the '745 patent reads as follows: A visually transparent, infrared reflecting parent support having adhered to one surface thereof an interference filter having a plurality of continuous directly contiguous stacked layers, said layers comprising: (a) a dielectric

layer, (b) a discrete sputter-deposited transparent metal layer, (c) one or more pairs of layers, each pair comprising a dielectric spacer layer and a discrete sputter-deposited transparent metal layer, and (d) a dielectric outer layer, wherein the dielectric is a sputter-deposited dielectric; the metal layers each comprise silver and each are from 4 to 17 nm in thickness and the dielectric layers each have an index of refraction of from about 1.75 to about 2.25 with the spacer layers having a thickness of from 70 to 100 nm and outer layers having a thickness of from about 30 nm to about 70 nm. See Cardinal's Declaration of Caroline N. Mitchell, Exhibit 27.

Claim 36 of the '745 patent is the same as claim 14 except that the specified thickness of the spacer layer in the last clause is different than that in claim 14.

Cardinal's LOE² product and process for heat mirrors also employs a two-silver layer Fabry-Perot filter. It consists of the following layers on top of the glass: a zinc oxide dielectric, silver, a titanium "sacrificial 'barrier' layer", another zinc oxide dielectric, silver, another titanium "sacrificial 'barrier' layer", another zinc oxide dielectric, a titanium dioxide dielectric, and another zinc oxide dielectric. The dielectric layer in the Cardinal product is produced by a two-step process in which a metal layer is first deposited and is then oxidized.

DISCUSSION

I. Infringement of claims 14 and 36 of the '745 patent

What is the meaning of "sputter-deposited dielectric" in the '745 patent? In this lawsuit Southwall asserts that

claims 14 and 36 of its '745 patent are infringed. Both claims 14 and 36 contain a limitation that "the dielectric layers are sputter-deposited." In the patent specifications "sputter-deposited" is defined as "the process (or) the product of the process in which a layer of material is laid down by the use of a magnetron sputterer." Cardinal contends that in the prosecution history of the '745 patent Southwall told the Examiner that the term "sputter-deposited dielectric" refers to a dielectric that is "laid down as a sputter-deposited inorganic metal oxide, compound, or salt," and does not include the methodology used by Cardinal in forming a dielectric.

The doctrine of prosecution estoppel precludes a patent owner from asserting a claim construction that was surrendered during the prosecution of the patent application. Hughes Aircraft Co. v. United States, 717 F.2d 1351, 1362 (Fed.Cir.1983). The estoppel applies to claim amendments to overcome rejections based on prior art, Dwyer v. United States, 357 F.2d 978 (Ct.Cl.1966), and to arguments submitted to obtain the patent. Coleco Industries, Inc. v. United States International Trade Commission, 573 F.2d 1247 (C.C.P.A.1978), cited in Hughes Aircraft, 717 F.2d at 1362.

In order to consider the estoppel argument advanced by Cardinal, it is necessary to examine the prosecution history of those claims. It is in the nature of things that some patent prosecution histories must be more complex than others. This particular prosecution history is at the complex end of this continuum.

To begin, it is to be noted that the numbers assigned to claims in issued patents are frequently not the same

numbers given to those claims when they were originally stated in the patent application. During the prosecution process some claims may be rejected, some combined, some amended – to describe only the readily apparent changes that can take place. As a result of this process, the patent claims as issued frequently require renumbering to state sequentially numbered claims as they survive the prosecution process. For purposes of analyzing this history the Court will label the original claims in the patent application as A1, A2, etc. and the claims in the issued patent as P1, P2, etc. This case has an additional complication as there was a Reexamination by the Patent Office and the resulting Certificate again resulted in renumbered claims based upon that particular prosecution history. The claims reviewed in the reexamination process will be referred to as R1, R2, etc., as they start the process, and as RP1, RP2, etc., as they finish it. Our problem, then, is one of patent claim genealogy – which original claims begat RP14 and RP36 now assertedly infringed? The parties used different starting perspectives to accomplish this study, and the Court appreciates their efforts, but the Court will attempt to do this by a straight-line chronological approach.

June 30, 1986. Southwall presented to the Patent Office an application containing thirty-two claims. We start our review by focusing on two of these claims, A5 and A16. Claim A5 was a dependent claim part of a cluster of dependent claims to independent claim A1 and added the limitation, " . . . wherein the dielectric layers are sputter deposited." Similarly, claim A16 was a dependent claim to independent claim A10 and added the limitation, " . . . wherein the dielectric is a sputter-

deposited dielectric." We should also note that claim A17 was dependent to claim A16 and claim A20 was dependent to claim A17.

November 3, 1987. Following rejection by the Patent Office of claims A1 to A7 as indefinite, Southwall cancelled claims A1 to A3 and amended claim A4 to be an independent claim with unamended claim 5 now stated as dependent to independent claim A4.

January 22, 1988. Following telephone discussions with the Patent Office, Southwall restructured its claims by replacing claims A11 to A13 with claims A33 to A35. Claim A33 replaced claim A11 but was now stated as an independent claim. Claim A16 was now stated as a dependent claim to A33 and kept its "sputter-deposited dielectric" limitation. In this restructuring, claim A17 was cancelled but claim A20 remained as a dependent to A16.

March 28, 1988. In an Office Action on this date the Examiner renumbered claim A5 as claim A40. This renumbering was apparently based on an erroneous conclusion of the Examiner that Southwall had cancelled claim A5 in its January 22, 1988 amendment. The result, however, is that the original text of claim A5, including the "dielectric layers are sputter-deposited," limitation was retained in claim A40 which was now a dependent claim to independent claim A4.

July 8, 1988. In an Official Action on this date the Examiner rejected all the pending claims, citing the Franz and Yatabe patents as invalidating prior art references. The Examiner offered two basic reasons for his actions, one related to the meaning of "directly deposited" in certain of the claims, and the other related to the "sputter-deposited dielectric" limitation.

As to "directly deposited" the Examiner stated: In claims 8-10, 23, 36, 38 and 39 it is unclear what is meant by "directly." Clarification is requested. In claim 33, as agreed in the telephone interview "directly" was inadvertently omitted and should be inserted.

As to the "sputter-deposited dielectric" issue, the Examiner considered the Franz patent where alternate layers of metal/metal oxide are used in a heat window and the metal oxide is created by first depositing a metal layer and then heating the metal layer after it has been coated with a liquid surfactant. The Examiner explained that the Franz patent taught that "the metal oxide layer is sputter deposited as a metal and then oxidized." The Examiner then raised the following question: The metal oxide layer is sputter deposited as a metal and then oxidized, see column 4, lines 25-28. It is unclear whether the "metal oxide is sputter-deposited" limitation is meant to encompass this situation where the metal oxide is (s)putter deposited as a metal and later oxidized. Until clarification, the Examiner m(u)st interpret the claims broadly.

This language needs some interpretation inasmuch as there was no "metal oxide as sputter deposited" limitation in any of the patent claims. However, as already described, the patent specification defines "dielectrics" as "inorganic oxides." Since it is also true that "dielectric" and "oxide" are considered to be interchangeable terms, it is apparent that the "metal oxide" language of the Examiner should be read as "dielectric." Southwall acknowledges that this is the proper way to read the Examiner's question. It is clear then that the Examiner's

question related to the sputter-deposited limitation stated in both claims A5 and A16.

August 19, 1988. Southwall submitted a response to the rejection action of the Examiner.

As to the "directly deposited" issue Southwall took the amendatory action required and stated in explanation: The office action also requested clarification of the term "directly" as used in claims 8-10, 23, 36, 38, and 39. By the present amendment, claim 33 now recites the term "directly" and thus should also fall within this group. The term "directly" as used in the claims is intended to mean that the layers are present or laid down contiguous with one another without intervening layers.

On the sputter-deposited dielectric issue, Southwall amended independent claim A4 by adding the following limitation language to a dielectric layer specified in the claim: " . . . sputter-deposited inorganic metal oxide, compound or salt." Southwall explained its amendment as follows: It is believed that the claims as last presented distinguished patentably over the Franz and Yatabe disclosure but to provide yet additional clear bases for distinction the claims have been amended to specify that the dielectric layer is laid down as a sputter-deposited inorganic metal oxide, compound or salt, and further: As pointed out in the specification, such layers can be laid down directly by reactive sputtering processes in which the metal is sputtered off of a metal target and directly converted to the oxide, compound or salt by the presence of a gaseous reactant.

Southwall did not offer any amendment to dependent claim A16 in this response to the Examiner.

January 24, 1989. The '745 patent was issued with 25 renumbered claims. Claim A33 became issued independent claim P8. Claim A16 became issued claim P13 dependent on P8, and claim A20 became issued claim P14, dependent on claim P13. The original "sputter-deposited dielectric" limitation of claim A16 had not been amended during the prosecution process and was now stated as a limitation in claim P13 and also as a limitation in claim P14 inasmuch as that claim was dependent on claim P13.

At the same time claim A4 was issued as independent claim P4. This claim contained the new "sputter-deposited inorganic metal oxide, compound or salt dielectric" limitation which had been added to claim A4 by Southwall in its amendment of August 19, 1988. In his notice of allowability issued on August 29, 1988, the Examiner decided that claim A40, the renumbered original claim A5, should be cancelled. It appears that this action was taken because the "dielectric layers are sputter-deposited" language of dependent claim A40 was not considered by the Examiner to be a distinguishable limitation from the new "sputter deposited organic metal oxide, compound or salt dielectric" limitation of the independent claim issued as P4. The Examiner held a telephone conference with Southwall on this issue and Southwall agreed to cancel claim A40.

At the same time, however, the same "sputter deposited dielectric" limitation was allowed in issued dependent claim P13 of issued independent claim P8. This limitation had been originally stated in dependent claim A16 and was now issued without any change in dependent claim P13 of the '745 patent.

December 6, 1990. Southwall requested reexamination of the '745 patent in order to permit the Patent Office to examine prior art which had not been considered when the original '745 patent application was prosecuted. Southwall requested reexamination of the issued claims P1 to P25, which we will now describe as RA1 to RA25 as well as newly submitted claims RA26 to RA37.

August 5, 1991. In its first Office Action in the reexamination process the Examiner held that claims RA1 to RA4, RA6 to RA13, RA17 to RA25, RA36, and RA37 were unpatentable. The Examiner also held that claims RA14 to RA16 could be patentable if they were rewritten in independent form.

October 7, 1991. Southwall responded to the Office Action by cancelling all claims except RA5, RA14 to RA16, and RA26 to RA35. In this response claim RA14 was rewritten as an independent claim incorporating all the limitations of RA8 (P8) and RA13 (P13). At the same time Southwall presented new independent claim RA38 which was identical to the new independent claim RA14 except that it defined a different thickness for the spacer layer stated in the last clause of each claim.

January 6, 1992. The Patent Office issued Reexamination Certificate B1 4,799,745 containing issued patent claims RP14 and RP36, a new number for RA38 assigned at the conclusion of the reexamination process.

We can now chart the genealogy which shows that the relevant limitation language of RP14 and RP36 was first stated in the patent application at claim A16.

HISTORICAL SUMMARY

6-30-86 Application Process	1-2-88 Amendment Process	8-19-88 Amendment	1-24-88 Patent Issued	12-6-90 Reexamination	1-6-92 Reexamination
A10 Indep.					
A11 Depen. to A10	A33 Indep.		P8 Indep.		
A13 Depen. to A10					
A16 Depen. to A10	A16 Depen. to A33		P13 Depen. to P8		
A17 Depen. to A16					
A20 Depen. to A17	A20 Depen. to A16		P14 Depen. to P13	RA14 Indep. Incorporates P8 and P13	RP14
RA38 Indep. Incorporates P8 and P13	RP36				
A1 Indep.	A4 Indep.	A4 Indep.	P4 Indep.	RA4	
A5 Depen. to A1	A40 Depen. to A4	A40 Depen. to A4			

The original limitation language of application Claim A16 – "Wherein the dielectric layers are sputter-deposited" – is contained in the issued patent in dependent claim P13. That same limitation appears in application claim A20 because claim A20 is dependent to claim A16, and is contained in issued patent claim P14 (nee A20) which is dependent to claim P13 (nee A16). In the reexamination process that limitation language is carried into independent claim RA14 when that claim is restated as an independent claim incorporating RA8 (P8) and RA13 (P13) and is now found in issued reexamination patent claim RP14 and is additionally found in new independent claim RP36. It is noted that that limitation language was stated in the original application and was not amended throughout the prosecution history and the reexamination process.

The original limitation language of application Claim A5 – "whenever the dielectric layers are sputter-deposited" – was carried forward to dependent claim A40 and then cancelled by Examiner amendment because its independent claim A4 has been amended to include the limitation, " – sputter-deposited inorganic metal oxide, compound, or salt dielectric." While the patent application claim A4 was issued as claim P4, it was eliminated in the reexamination process and is not stated in the reexamination patent. As a consequence, the original limitation language of claim A5 and the amendment limitation language of claim A4 survived the prosecution history as claim P4 in the issued patent, but did not survive the reexamination process.

We now return to the central question as to the meaning of "sputter-deposited dielectric." From the prosecution history we know what it is and what it is not. It is a dielectric layer which has been formed or "laid down" as a metal oxide by a direct one step process. It is not a dielectric layer which has been formed by an indirect, two-step process where a metal layer is deposited and is later oxidized. It is clear that the Examiner deemed the two-step process to be unpatentable in light of the Franz prior art.

Southwall now contends that in addition to its explanation that the "dielectric layer is laid down as a sputter-deposited inorganic metal oxide," it explained to the Examiner that "such layer can be laid down . . . and directly converted to the oxide, compound, or salt. . . ." Southwall contends that this statement should be interpreted as a description of but one example of different processes used to form a dielectric and that, therefore, other processes of forming dielectrics must also be included in the patent. This argument simply ignores the fact that the Examiner rejected two-step processes in light of Franz. There is nothing in the prosecution history to support the notion that this rejection was anything other than absolute.

Southwall further contends that any estoppel from the prosecution history relates only to cancelled claim P4 which was amended by Southwall on August 19, 1988, and not to claims RP14 and RP36 which contain limitation language which was unamended throughout the prosecution history. This contention is also unavailing. The history shows that original claim A16 states the same

limitation as original claim A5. Claim A5 was renumbered in the history as A40 and was then cancelled as being redundant to the new limitation language added to independent claim A4 by Southwall's August 19, 1988 response. The Examiner did not cancel claim A16 but this is because it was not redundant in the family of claims to which it was dependent. This history does not change the fact that original claim A16 was still the same as original claim A5. A patentee is bound by the definitions it provides to the Patent Office. Lear Siegler, Inc. v. Aeroquip Corporation, 733 F.2d 881 (Fed.Cir.1984). The definition provided by Southwall to original claim A5 (renumbered as A40) in its August 19, 1988 response applies with equal force to original claim A16 now asserted as the basis for infringement in claims RP14 and RP36.

Inasmuch as the prosecution history establishes a direct, one-step dielectric forming process as an element of the patent, the Cardinal product, which admittedly does not have this element, does not literally infringe the patent. Literal infringement occurs only when the accused device embodies every element of the patent. Builders Concrete, Inc. v. Bremerton Concrete Products Company, 757 F.2d 255 (Fed.Cir.1985); Lemelson v. United States, 752 F.2d 1538 (Fed.Cir.1985).

Southwall contends, however, that even if the Court finds no literal infringement, that the Court should, nevertheless, find infringement pursuant to the Doctrine of Equivalents. Under the Doctrine of Equivalents, an accused product that does not literally infringe a claim may infringe "if it performs substantially the same function in substantially the same way to obtain the same

result." Graver Tank & Mfg. Co., Inc. v. Linde Air Products Co., 70 S.Ct. 854 (1950). The Doctrine of Equivalents, however, is limited by prosecution history estoppel, which "limits a patentee's reliance on the Doctrine of Equivalents by preventing him from contending later that in an infringement action that his claims should be interpreted as if limitations added by amendment were not present. . . . " Thomas & Betts Corporation v. Litton Systems, Inc., 720 F.2d 1572 (Fed.Cir.1983). Southwall points out, however, that the rule of prosecution history estoppel includes a recognition of "partial recapture" and the fact that a patent applicant narrows his claim to secure a patent does not always mean that the patentee may not recapture some of what was originally claimed. The amount of coverage retained in this regard depends on the circumstances of the case. Pennwalt Corporation v. Durand-Wayland, Inc., 833 F.2d 931 (Fed.Cir.1987). Southwall concedes that a dielectric formed by the process used in the Franz patent could not be "recaptured" but that the Cardinal process is sufficiently different from Franz to cause a question of fact as to whether or not Cardinal infringes pursuant to the Doctrine of Equivalents. Even assuming the existence of a theory of partial recapture, it does not apply in this case. The Examiner specifically rejected any process where the "metal oxide is [s]putter-deposited as a metal and later oxidized." The Cardinal process is such a process. The result is that, although the Cardinal process may arguably be different than Franz, it is definitely a process that the Examiner deemed to be unpatentable. Infringement under the Doctrine of Equivalents "does not mean that one can ignore claim limitations." Pennwalt Corp., 833 F.2d at 935.

Southwall's Doctrine of Equivalents contention succeeds only if the claim limitation established in the prosecution history is ignored. Accordingly, Southwall cannot establish literal infringement or infringement by the Doctrine of Equivalents, and the motion for summary judgment by Cardinal on the issue of infringement must be GRANTED.

II. Invalidity Due to Failure to Disclose Best Mode

Section 112 of the patent laws states that: The specification shall contain a written description of the invention, and of the manner and process of making and using it . . . and shall set forth the best mode contemplated by the inventor of carrying out his invention. 35 U.S.C. § 112. To prevail on this defense, Cardinal must prove two elements. First, there must have been a preferred mode that was not disclosed in the application for the patents. Northern Telecom, Inc. v. Datapoint Corp., 908 F.2d 931, 940 (Fed.Cir.1990). Second, the Southwall inventors must have known at the time they filed the patent application that there was a mode of practicing the invention that was better than the mode disclosed in the patent. W.L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 1556 (Fed.Cir.1983). This is a subjective determination that depends on the state of mind of the inventors at the time of the invention. It involves comparing what the inventors knew about the invention with what they disclosed in the patent application. If the inventors did not disclose enough information to enable a person of ordinary skill in the art to practice the best mode of the invention, then the inventors are considered to have

"concealed" the best mode rather than disclose it as required by the patent laws.

Cardinal argues that the best mode of the invention included the use of hydrogen gas to protect the silver from oxidation during the coating of the dielectric rather than the application of an additional layer to protect the silver. Southwall expressly stated that the improvement of its invention over the existing technology was the elimination of the additional protective layer. Southwall eliminated this layer by employing its hydrogen gas process to protect the silver. Thus, Cardinal argues, because Southwall did not disclose the hydrogen gas process in its patent application, Southwall knowingly failed to disclose the best mode of enabling the invention in violation of § 112. Cardinal goes on to argue that not only did Southwall not disclose the best mode, but it steadfastly maintained the process as a trade secret. This was in clear contravention of the underlying policy of the patent laws, which requires a quid pro quo of disclosure of the invention in exchange for the granting of a seventeen-year monopoly.

Southwall responds first that its inventors chose the hydrogen gas method to protect the silver layer, but did not consider it the best mode. Indeed, they believed Cardinal's sacrificial titanium barrier layer was the best mode, but elected to use the hydrogen gas method because of certain constraints in their drum processing apparatus of their equipment. As Thomas G. Hood, Vice President of Marketing and Sales at Southwall and named inventor of the '745 patent, stated in his declaration: 10. Because, in the circular drum-type processing equipment we are using at Southwall, the processing path length is

restricted, and because we have a limited number of cathodes available for use, we have elected to use the hydrogen gas technique to protect the silver rather than the protective sacrificial barrier layer process which Cardinal employs. 11. Our use of hydrogen gas instead of a sacrificial barrier layer in no way implies that it is the "best mode" for practicing our invention. I have never considered it to be the "best mode." The use of hydrogen gas is now, and was in 1986, one known method for protecting silver which had been previously placed in use at Southwall as a result of process equipment restrictions, with known and obvious advantages and disadvantages relative to the sacrificial barrier layer method. 12. . . . I did not in 1986 and do not today believe that the use of hydrogen gas is the best way to practice the invention of the '745 patent. Declaration of Thomas G. Hood in Opposition to Cardinal's Motion for Summary Judgment at 3-5.

In addition, Southwall submits that its inventors could not have intentionally concealed the hydrogen gas process as a trade secret since it has been in the public domain since December of 1983. As Mr. Hood explained: 5. The use of hydrogen to protect the silver layers comprising our invention was not what we understood we were claiming as our invention in what became the '745 patent. We applied for the '745 patent in June of 1986. Southwall had been using hydrogen in its coating process with respect to single silver layer films since before I joined the company in 1981. Thus, the hydrogen gas method was not unique to the multiple silver layer Fabry-Perot coating claimed in the '745 patent. 6. It is true that Southwall generally considers proprietary the precise

conditions under which its processing machinery operates, and that, for a time, Southwall specifically viewed the use of hydrogen gas to protect silver layers to be proprietary information. Once U.S. Patent No. 4,421,622 (the "Hollars Patent") was issued to Dennis Hollars in 1983, however, which patent fully disclosed the hydrogen gas method of protecting silver layers to the optical coating industry, we understood that the method would thereafter generally be known to those of ordinary skill in the optical art. . . . I believed the issuance of the Hollars Patent had disclosed to the industry the use of hydrogen to protect the silver even though the business people at Southwall consider all of our process details to be "proprietary" in some sense. Declaration of Thomas G. Hood in Opposition to Cardinal's Motion for Summary Judgment at 2-3.

The question of summary judgment based on failure to disclose the best mode comes down to whether Southwall's use of hydrogen gas was the best way known by the inventors to make the invention. The inventors at Southwall claim that it was not, while Cardinal claims that it must have been because it was the only way they were able to eliminate the unnecessary layers in the heat mirrors, which is the primary contribution of the patented invention. In light of the foregoing, the Court finds that without further evidence describing the technology of heat mirrors, for example, how Southwall would be able to eliminate the extra layer without using the hydrogen gas method, how this method compares with Cardinal's method, and what the state of the art was at the time of the invention, the Court cannot find that there are no

genuine issues of fact in dispute that would justify summary judgment in favor of Cardinal. Accordingly, the Court DENIES Cardinal's motion for summary judgment on the issue of invalidity due to failure to disclose the best mode.

III. Invalidity Due to Anticipation by a Prior Publication

Cardinal moves for summary judgment contending that the '745 patent is invalid because it is anticipated by an article published by Peter H. Berning in the December 1983 issue of Applied Optics (the Berning article).

Section 102(b) of the patent laws states that a "person shall be entitled to a patent unless . . . the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States. . . . " 35 U.S.C. § 102(b).

Cardinal argues that each element of claims 14 and 36 is fully disclosed in the Berning article. The relevant passage of the Berning article states that a variety of methods exists for the application of architectural films, principally, vacuum deposition methods (sputtering and thermal evaporation), dip-coating and spray prolysis, and electroless chemical deposition. Berning at 4127 (emphasis added). Cardinal argues that one skilled in the art would know that the sputter process referred to in this passage of the Berning article included DC magnetron sputter deposition. Thus, each element of claims 14 and 36 of the '745 patent is fully disclosed in the Berning article.

Southwall admits that the design disclosed in Berning's Figure 26 falls within the claims, but responds that the Berning article is "a highly idealized, theoretical, practically unrealistic, conceptual description of a possible coating" that not only does not disclose each element of the '745 patent, but "teaches away" from it. Southwall's Opposition at 6.

The question of whether a hypothetical person with ordinary skill in the art would know that the sputter process referred to in the Berning article included sputter deposition with DC magnetron is a fact-specific question. The Court finds that genuine issues of material fact remain on this issue and DENIES Cardinal's motion for summary judgment on invalidity due to anticipation by a prior publication.

IV. Invalidity Due to Obviousness

Finally, Cardinal submits that the '745 patent is invalid because it is obvious in light of the prior art. Section 103 of the patent law states: A patent may not be obtained . . . if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. 35 U.S.C. § 103.

There are four factual inquiries to consider in deciding the issue of obviousness: (1) the scope and content of the prior art relied upon against the patent in suit; (2) the differences, if any, between the prior art and the claims at

issue; (3) the level of skill of the ordinary person skilled in the pertinent art at the time the invention was made; and (4) the objective evidence of obviousness or nonobviousness or evidence of secondary considerations, including the commercial success of the invention, the long-felt need for the invention, the failure of others to invent the process, the unexpected results of the invention, the decisions by persons to copy the invention instead of copying the prior art, and the independent development of the patented process by persons other than the inventors. Graham v. John Deere Co., 86 S.Ct. 684, 694 (1966).

Cardinal submits that the '745 patent was obvious in light of the Berning article because of the rule that when a claim is rejected over the prior art and that claim is canceled by the patent applicant, the scope and content of the canceled claim is admitted by the applicant to be within the prior art. Lemelson v. General Mills, 968 F.2d 1202, 1207-08 (Fed.Cir.1992). Here, Cardinal argues that Southwall conceded that the use of a sputter deposition process is obvious because the only difference between canceled claim 13 of the original patent (issued claim P13 renumbered from application claim A16) and claim 14 (RP14) of the current issued patent is that claim 14 specifies the use of silver and certain specific numerical limitations of the various layers of the coating. Thus, these are the inventive features, and all else, including the use of a sputter deposition process must be non-obvious.

Cardinal also argues that the '745 patent is obvious in light of the Berning article because "every element of claims 14 and 36 of the patent is disclosed in the prior art." Cardinal's Motion for Summary Judgment at 38. In

addition, the Berning article provides the necessary suggestion to combine the prior art with the thicknesses contained in the Berning article to produce the claimed invention.

The relevant inquiry for the Court is the knowledge of a hypothetical person of ordinary skill in the art, not that of the inventor. Therefore, Southwall's response that Stephen Meyer, the inventor of the '745 patent, was unaware of the existence of the Berning article until recently is irrelevant. Southwall also points to a number of key differences between the Berning article and the '745 patent, including the fact that the use of DC magnetron sputter deposition techniques to produce the Fabry-Perot coating is one of the principal novel aspects of the invention of the '745 patent and is not disclosed in the Berning article and the assertion that the Berning article "teaches away" from the elimination of the nucleation layer.

The summary judgment motion on obviousness follows the same analysis as the summary judgment motion on anticipation by prior publication. Accordingly, the Court finds that genuine issues of material fact remain and DENIES Cardinal's motion for summary judgment in invalidity due to obviousness.

CONCLUSION

For the foregoing reasons, the Court ORDERS as follows:

I. Cardinal's motion for summary judgment on non-infringement of '745 patent either literally or under the Doctrine of Equivalents is GRANTED.

II. Cardinal's motion for summary judgment on invalidity of the '745 patent for failure to disclose the best mode of the invention is DENIED.

III. Cardinal's motion for summary judgment on invalidity of the '745 patent due to anticipation by prior publication is DENIED.

IV. Cardinal's motion for summary judgment on invalidity of the '745 patent due to obviousness in light of the prior art is DENIED.

VI. A status conference is scheduled in this matter for March 23, 1994, at 8:30 a.m.

IT IS SO ORDERED.

United States Court of Appeals for the Federal Circuit

94-1243

SOUTHWALL TECHNOLOGIES, INC.,

Plaintiff-Appellant,

v.

CARDINAL IG COMPANY,

Defendant-Appellee.

ORDER

A combined petition for rehearing and suggestion for rehearing in banc having been filed by the APPELLANT, and the petition for rehearing having been referred to the panel that heard the appeal, and thereafter the suggestion for rehearing in banc having been referred to the circuit judges who are in regular active service,

UPON CONSIDERATION THEREOF, it is

ORDERED that the petition for rehearing be, and the same hereby is DENIED and it is further

ORDERED that the suggestion for rehearing in banc be, and the same hereby is, DECLINED.

The mandate of the court will issue on June 28, 1995.

FOR THE COURT,
FRANCIS X. GINDHART,
CLERK

Dated: June 21, 1995

By: _____
Diane M. Frye
Chief Deputy Clerk

cc: WILLIAM L. ANTHONY, JR.
V. BRYAN MEDLOCK, JR.

SOUTHWALL V CARDINAL IG 94-1243
(DCT - 92-CV-327)

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Note: Pursuant to Fed. Cir. R. 47.6, this order is not citable as precedent. It is a public record.

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United States Patent [19]

Meyer et al.

[11] **Patent Number: 4,799,745**
[45] **Date of Patent: Jan. 24, 1989**

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[54] HEAT REFLECTING COMPOSITE FILMS AND GLAZING PRODUCTS CONTAINING THE SAME

[75] Inventors: **Stephen F. Meyer,** Los Altos; **Thomas G. Hood,** San Francisco, both of Calif.

[73] Assignee: **Southwall Technologies, Inc.,** Palo Alto, Calif.

[21] Appl. No.: **880,797**

[22] Filed: **Jun. 30, 1986**

[51] Int. Cl.[4].....GO2B 5/28; C23C4/00

[52] U.S. Cl.....350/1.7; 204/192.27

[58] Field of Search.....350/1/7; 204/192.27

[56] References Cited

U.S. PATENT DOCUMENTS

3,272,986	9/1966	Schmidt	350/1.7
3,682,528	8/1972	Apfel et al.	350/1
3,846,152	11/1974	Franz	350/1.7
3,900,673	8/1975	Mattimoe et al.	428/339
4,204,942	5/1980	Chahroudi	204/298
4,335,166	6/1982	Lizardo et al.	428/34
4,337,990	7/1982	Fan et al.	350/1.7
4,639,069	1/1987	Yatabe et al.	350/1.7

FOREIGN PATENT DOCUMENTS

0080182 6/1983 European Pat. Off.

OTHER PUBLICATIONS

Knittl, Zdenek, "Optics of Thin Films", John Wiley & Sons, Ltd., London, 1976, p. 284.

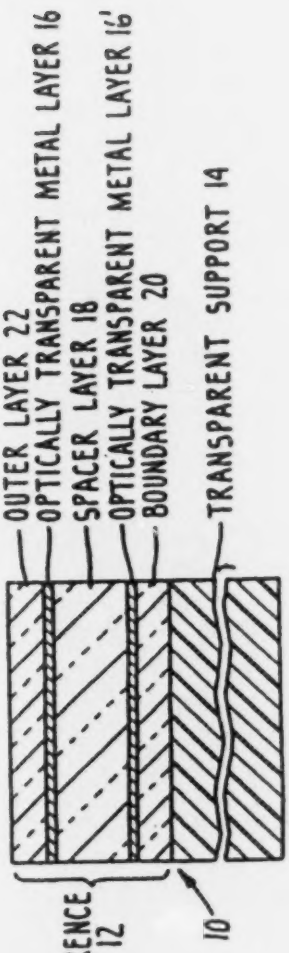
Primary Examiner – Bruce Y. Arnold

Attorney, Agent, or Firm – Ciotti & Murashige, Irell & Manella

[57] **ABSTRACT**

Visually transparent, infra-red reflecting films are disclosed for solar heat control. The films employ Fabry-Perot sandwich interference filters which are characterized by having two or more transparent layers of sputter-deposited metal such as silver directly contiguous with dielectric spacer layers and optionally boundary layers. Methods for producing these materials by sputtering techniques as well as glazing materials incorporating these films are disclosed, as well.

25 Claims, 4 Drawing Sheets


OUTER LAYER 22
OPTICALLY TRANSPARENT METAL LAYER 16
SPACER LAYER 18
OPTICALLY TRANSPARENT METAL LAYER 16'
BOUNDARY LAYER 20
TRANSPARENT SUPPORT 14
INTERFERENCE FILTER 12
10

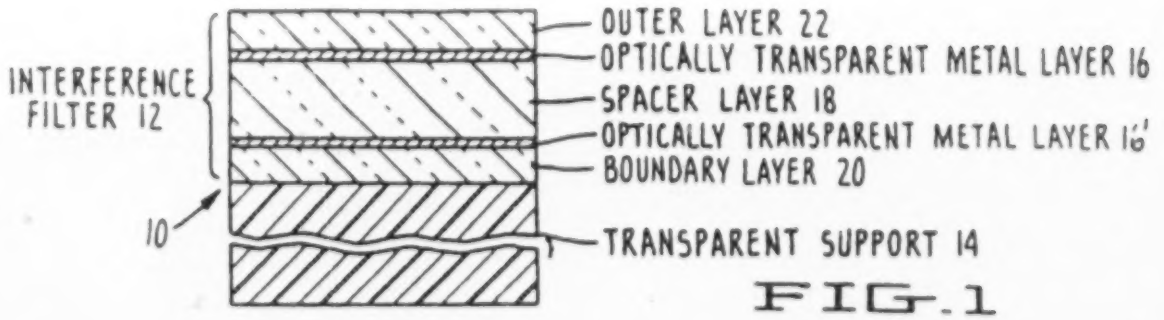


FIG. 1

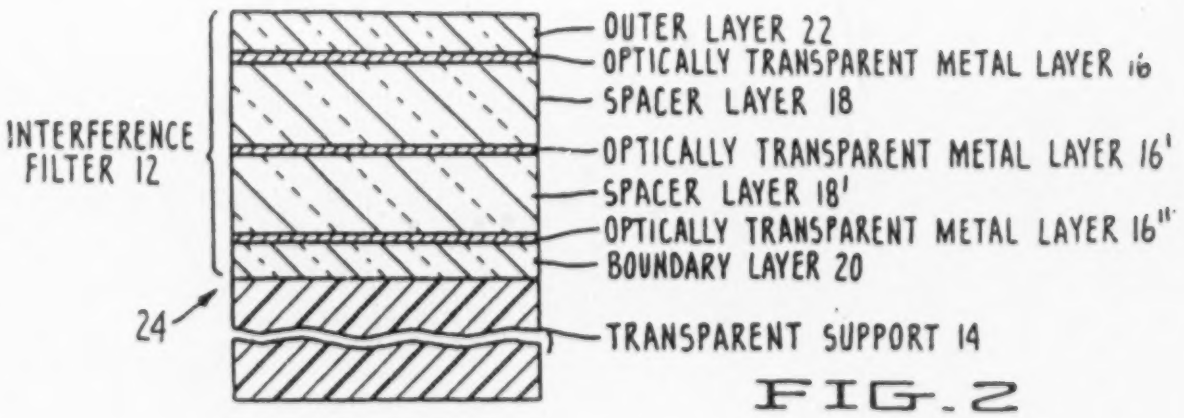


FIG. 2

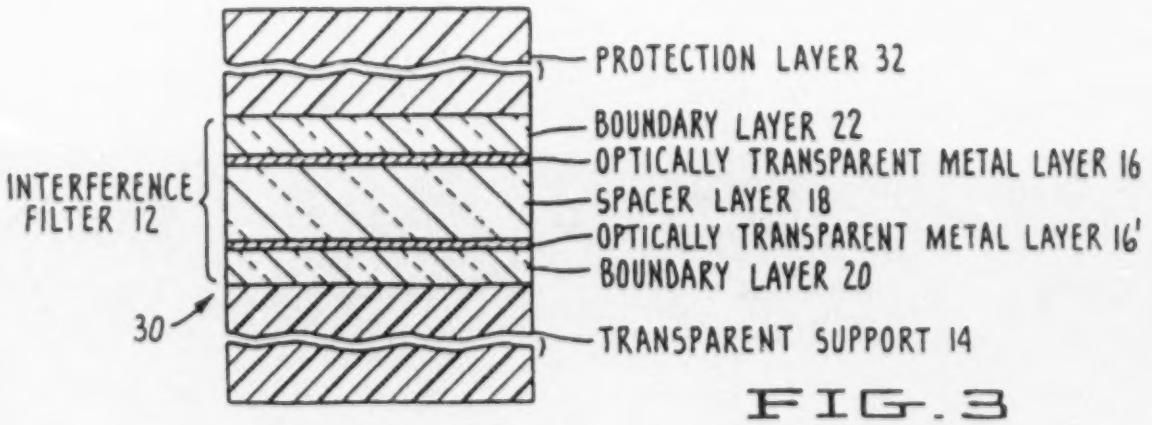


FIG. 3

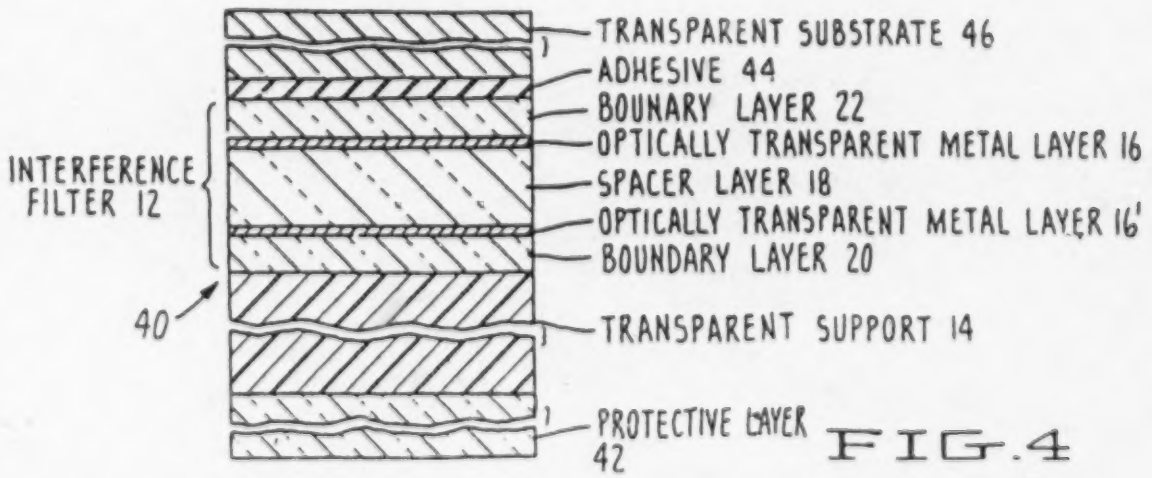


FIG. 4

64a

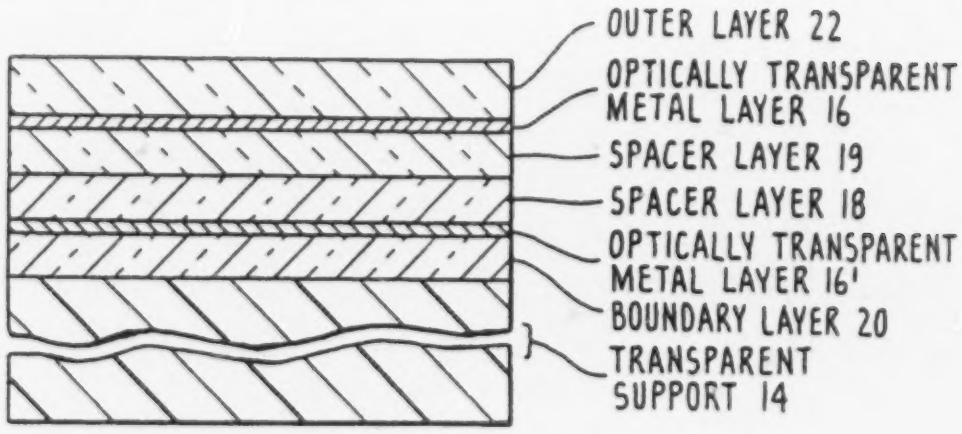

OUTER LAYER 22
OPTICALLY TRANSPARENT METAL LAYER 16
SPACER LAYER 19
SPACER LAYER 18
OPTICALLY TRANSPARENT METAL LAYER 16'
BOUNDARY LAYER 20
TRANSPARENT SUPPORT 14

FIG. 1A.

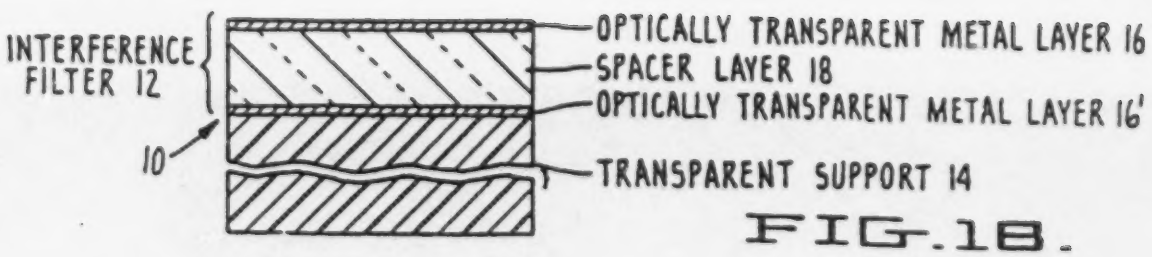

INTERFERENCE FILTER 12
10
OPTICALLY TRANSPARENT METAL LAYER 16
SPACER LAYER 18
OPTICALLY TRANSPARENT METAL LAYER 16'
TRANSPARENT SUPPORT 14

FIG. 1B.

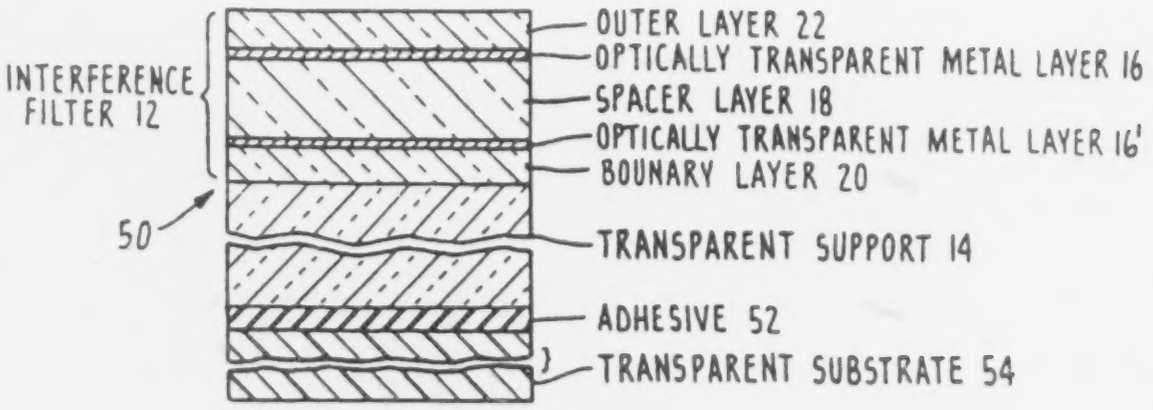


FIG. 5

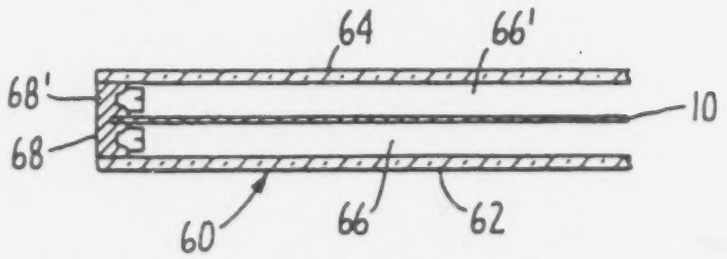


FIG. 6

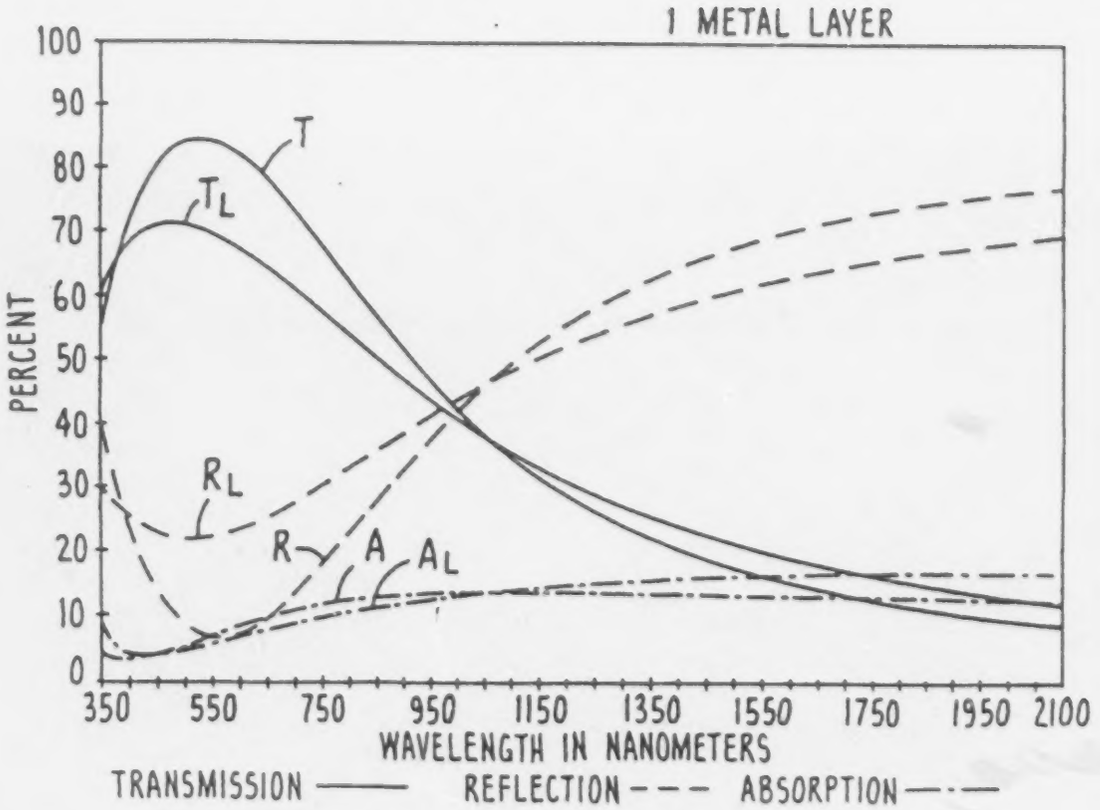


FIG. 7

66a

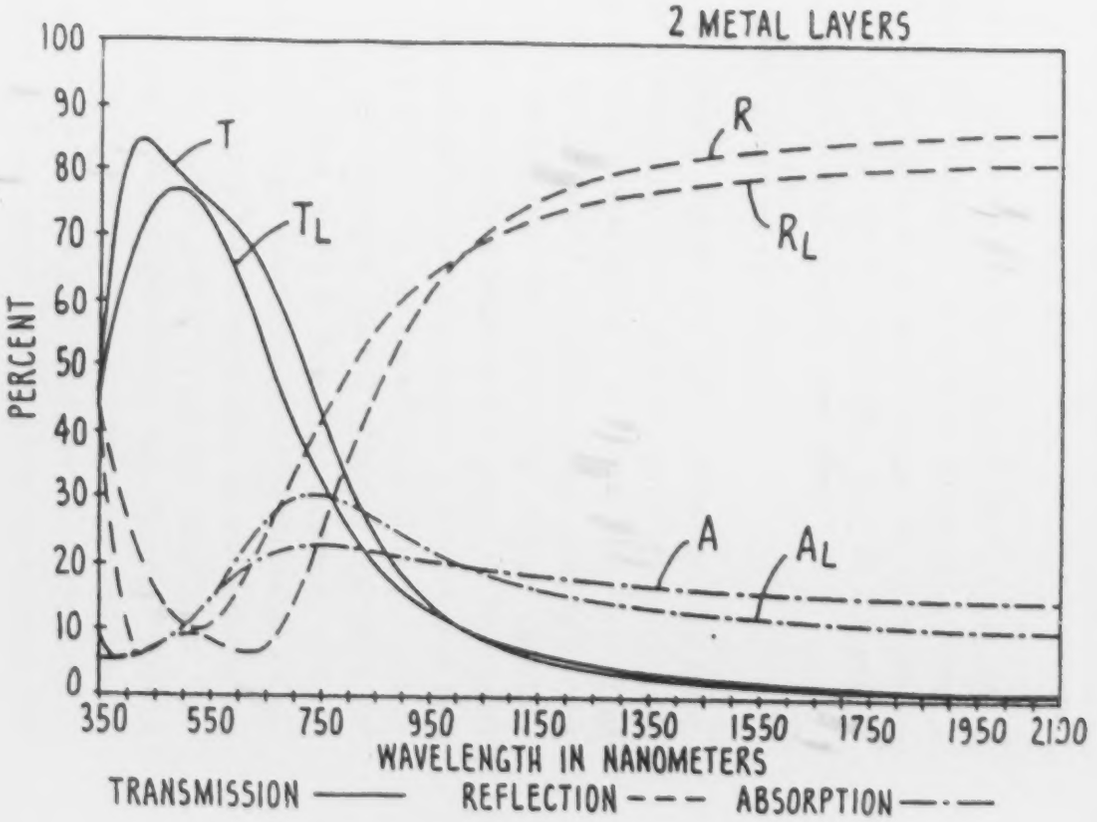


FIG. 8

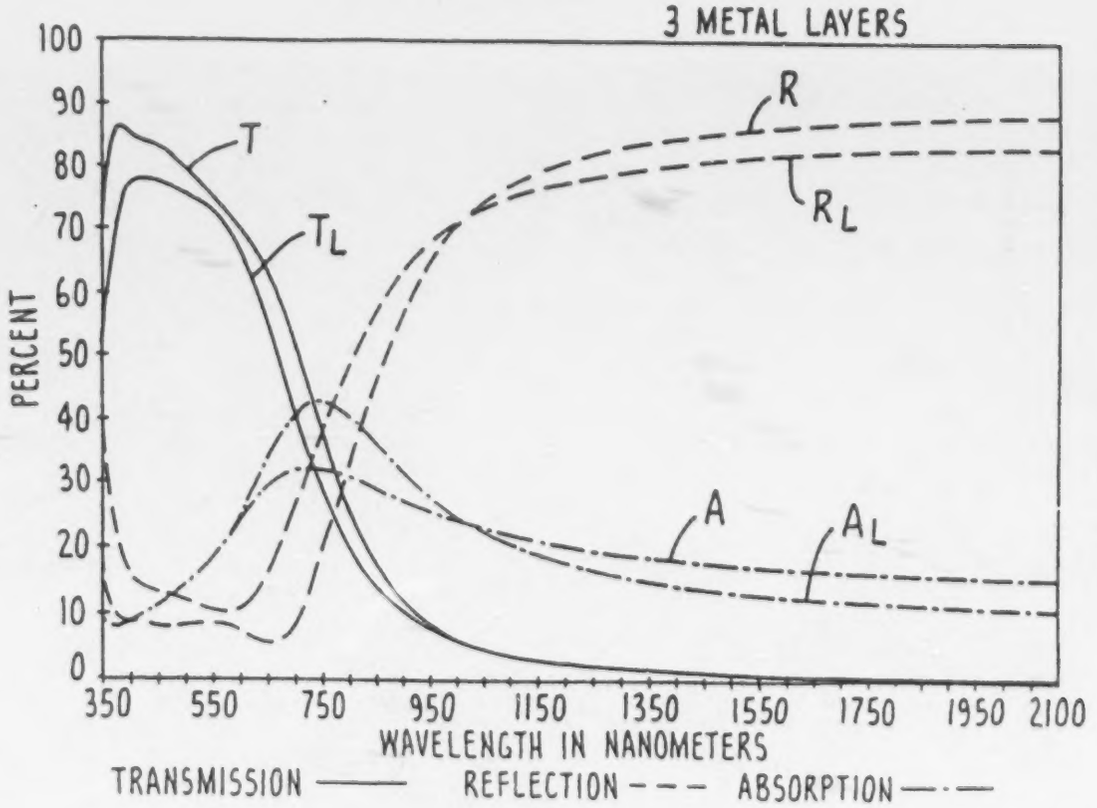


FIG. 9

67a

[col. 1] **HEAT REFLECTING COMPOSITE FILMS AND GLAZING PRODUCTS CONTAINING THE SAME**

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to heat reflecting films. More particularly, it relates to composite films comprising a series of dielectric and metal layers so as to create an infra-red reflecting interference filter and to the use of such films in window glazing materials.

2. Description of the Prior Art

In the 1890's, Fabry and Perot developed an interferometer consisting of a pair of parallel-sided half-silvered mirrors separated by a nonabsorbing layer. This device had the property of preferentially passing energy of certain wavelengths and reflecting energy of other wavelengths. An embodiment of this principle known as the the Fabry-Perot sandwich consists of two more or less transparent metal layers separated by a dielectric spacer layer. (See, for example, Knittl, Zdenek; OPTICS OF THIN FILMS, John Wiley & Sons, Ltd. London, 1976, at page 284.) Other filter products known as "induced transmission filters" have been constructed of metal-dielectric sandwiches for use in window glazing structures. One such structure is described in U.S. Pat. No. 4,337,990 of Fan (July 6, 1982) as consisting of a transparent substrate, overlayered with a phase matching layer, a single metallic silver layer and an outer antireflection layer, with the three overlayers constituting a transparent heat reflector. While generally effective, products of this general structure suffer from the disadvantage that to achieve high levels of heat reflection they must have relatively thick

metal layers such as 15 to 25 nm in thickness which tend to have low transmittances of visible radiation, as well.

Another system which used a Fabry-Perot approach to achieve heat reflection while transmitting visible radiation is shown in U.S. Pat. No. 3,682,528 of Apfel and Gilber Aug. 8, 1972). In this system, thinner layers of metal are employed but it is taught that to obtain such layers of an optically suitable metal, in particular silver, it is necessary to first lay down a thin "nucleation" precoat layer of nickel by vacuum deposition and then apply the silver to it, again by vacuum deposition methods. It is further taught that the deposited silver must then receive a thin postcoat layer of vapor-deposited nickel if another layer is to be applied over it. These extra coatings with nickel are time consuming and economically unattractive. This patent also discloses a filter having two silver layers but shows that each silver layer must be accompanied by one or two nickel layers and suggests only durability advantages to this more involved structure. The substrate upon which this multi-layer heat reflecting film was constructed most commonly was glass which, being rigid and heavy in weight, added to the difficulties of fabrication.

SUMMARY OF THE INVENTION

It is a general object of this invention to provide an improved transparent film which will selectively reflect heat, that is infra-red radiation.

It is a further object to provide a transparent film which has superior visual transparency with enhanced infra-red reflection.

It is yet a further object to provide a Fabry-Perot transparent film filter which has multiple metal layers [col. 2] but which minimizes the complexity and production difficulties attendant therewith.

It is also an object in certain embodiments of this invention to provide a heat reflecting transparent film which is plastic backed and has enhanced durability and scratch resistance.

It is an additional object to provide glazing structures incorporating these heat reflecting transparent films.

It has now been found that these and other related objects are achieved by employing in such films a Fabry-Perot filter incorporating a plurality of layers of sputter-deposited transparent metal separated from one another by directly contiguous spacer layers of dielectric. In preferred embodiments, the spacer layers are sputter-deposited inorganic oxides.

Thus in one aspect this invention involves improved transparent, infrared reflecting composite films including a transparent metal layer-dielectric layer Fabry-Perot interference filter adhered to a transparent support, wherein the improvement involves employing as the interference filter a multilayer stack including at least two separate discrete continuous sputter-deposited transparent metal layers separated from one another by discrete continuous layers of dielectric.

In another aspect this invention involves visually transparent, infrared reflecting composite films comprising a transparent support having adhered to one surface thereof two or more sequential interference filters each of

the filters comprising a continuous discrete sputter-deposited transparent metal layer directly sandwiched between continuous spacer layers of dielectric.

In further aspects this invention involves methods of producing such films by sputter-deposit techniques.

This invention can be embodied in many forms. It can take the form of plastic-supported sheets which may be interposed within or applied to transparent window glazing materials. It may take the form of a thin metal dielectric multilayer sandwich film laid down directly onto a glazing material substrate. In such applications the film may contain additional layers such as hard-coats.

DETAILED DESCRIPTION OF THE INVENTION

Brief description of the Drawings

In the drawings,

FIG.1 is a schematic cross-sectional view of a simple heat reflecting film of this invention employing two layers of sputter-deposited metal:

FIG. 1A is a schematic cross-sectional view of a heat reflecting film of this invention having two metal layers separated by a double spacer layer;

FIG. 1B is a schematic cross-sectional view of a very simple heat reflecting film of this invention having two metal layers separated by a double spacer layer and not including one or more outer or boundary layers;

FIG. 2 is a schematic cross-sectional view of a simple three metal layer heat reflector film of this invention;

FIG. 3 is a schematic cross-sectional view of a two metal layer heat reflector film of this invention having physical protection layer covering its Fabry-Perot filter;

FIG. 4 is a schematic cross-sectional view of a two metal layer heat reflector film of this invention having an optical protection layer on its transparent support [col. 3] and adhered to an additional transparent substrate via its filter layers which could serve as window glazing;

FIG. 5 is a schematic cross-sectional view of a film such as shown in FIG. 1 adhered to an additional transparent substrate via its support layer. This too could serve as window glazing;

FIG. 6 is a schematic cross-sectional view of a double pane window glazing incorporating a film of the invention;

FIG. 7 is a graph illustrating for comparison purposes the performance of a prior art reflecting film;

FIG. 8 is a graph illustrating the improved performance of a reflecting film of this invention having two transparent metal layers; and

FIG. 9 is a graph illustrating the improved performance of a reflecting film of this invention having three transparent metal layers.

DESCRIPTION OF PREFERRED EMBODIMENTS

Definitions

As used in this specification and the appended claims, the following terms have defined meanings:

"Visible radiation" or "light" means electromagnetic radiation having a wavelength of from 380 nanometers to 750 nanometers. (CIE Standard)

"Infrared radiation" or "heat" means electromagnetic radiation having a wavelength above 750 nanometers.

"Transparent" means having the property of transmitting visible radiation unless otherwise stated.

"Tvis" or "Tv" or "transmittance visible" each refer to a measure of transmittance over the visible wavelength. It is an integrated term covering the area under the transmittance vs. wavelength curve throughout the visible wavelengths. (1931 CIE Illuminant C Standard)

"Tsol" or "Ts" or "Transmittance solar" each refer to a measure of transmittance over all solar energy wavelengths. (ASTM E 424A) It is an integrated term covering the area under the transmittance vs. wavelength curve for both visible and infrared wavelengths. In heat reflecting films and glazings incorporating them it is a primary goal to decrease Tsol while maintaining Tvis as high as possible.

"SC" or "Shading Coefficient" is an accepted term in the field of architecture. It relates the heat gain obtained when an environment is exposed to solar radiation through a given area of opening or glazing to the heat gain obtained through the same area of 5/8 inch single pane clear glass. (ASHRAE Standard Calculation Method) The clear glass is assigned a value of 1.00. An SC value below 1.00 indicates better heat rejection than single pane clear glass. A value above 1.00 would be worse than the baseline clear single pane.

"Transparent metal layers" are homogeneous coherent metallic layers composed of silver, gold, platinum, palladium, aluminum, copper and nickel and alloys thereof of a thickness which permits substantial transparency.

"Sputter deposit" or "sputter-deposited" refers to the process of the product of the process in which a layer of material is laid down by the use of a magnetron sputterer.

"Dielectrics" are nonmetallic materials which are transparent to both visible and infrared radiation. Generally, these materials are inorganic oxides but other materials such as organic polymers may be included as well.

[col. 4] "Continguous" has its usual meaning of being in actual contact, i.e. of being adjoining. From time to time the somewhat redundant term "directly contiguous" is used for emphasis or clarification and has an identical meaning.

A "spacer layer" is a dielectric later located between and contiguous with two transparent metal layers. In FIG. 1, 18 is a spacer layer.

A "boundary layer" is a layer contiguous with one and not two transparent metal layers. In FIG 1, 20 and 22 are boundary layers.

Description of Filters

The present invention involves heat reflecting filters. A basic embodiment of these filters is shown as film 10 in FIG. 1. Film 10 includes a multilayer interference filter 12 directly adhered to a transparent support 14. Filter 12 operates according to the Fabry-Perot principle and

includes two transparent metal layers 16 and 16' separated by a spacer layer 18 and bonded by two outer or boundary layers 20 and 22.

In FIG. 1A, another embodiment of a film carrying a multilayer filter is shown. In this embodiment the spacer layer between the two metal layers 16 and 16' is itself made up of two continuous layers of dielectric 18 and 19 such that each of the metal layers is directly sandwiched between independent layers of dielectric. As can be seen by comparing FIGS. 1 and 1A, the center spacer layer is made up of dielectric and can be either a single layer (FIG. 1) or two contiguous layers (FIG. 1A).

Several features of this filter should be emphasized. The first is that the transparent metal layers are sputter-deposited. The second is that the spacer and boundary layers are directly contiguous with the transparent metal layers. No nucleation layers are required or employed with the sputtered transparent metal layers which the present invention incorporates.

As will be seen with reference to FIG. 2, more than two transparent metal layers, each separated from one another by a spacer layer can be employed. In theory, there is no limit to the number of transparent metal layers that can be used in these sandwich filters. In practice, however two to five transparent metal layers are preferred with two or three transparent metal layers being more preferred.

The thickness of the various layers in the filter should be controlled to achieve an optimum balance between desired infra-red reflectance and desired visible radiation transmittance. The ideal thicknesses can also

depend upon the nature of the transparent metal and dielectric employed.

Each of the transparent metal layers 16 and 16′ is from about 4 to about 40 nanometers (nm) in thickness, with the total thickness of metal generally being from about 12 to about 80 nm. With silver and silver alloyed with up to about 25% w of gold, which constitute preferred transparent metals, excellent results are obtained with two or three layers of metal, each from 4 to 17 nm in thickness especially from about 5 to about 13 nm.

In FIG. 1. the two transparent metal layers are depicted as of equal thickness. This is not a requirement of the present invention but is generally preferred for ease of fabrication. Because the transparent metals are sputter-deposited, the thickness of the deposits is a function of the sputtering conditions. If, as is usually most convenient and thus preferred, the conditions are held constant, the thicknesses of the layers will be constant.

[col. 5] The spacer layer 18 between the two transparent metal layers 16 and 16′ is between about 40 and about 200 nm in thickness. The preferred thicknesses selected within this range will depend upon the index of refraction of the dielectric employed. Spacer layers are preferably from about 50 to about 110 nm and especially from about 70 to about 100 nm in thickness for dielectrics having an index of refraction of from about 1.75 to about 2.25. Materials having an index of refraction within this range include the inorganic dielectrics such as metallic and semimetallic oxides for example indium oxide, tin oxide, titanium dioxide, silicon oxide, silicon dioxide,

bismuth oxide, chrominium oxide, as well as other inorganic metal compounds and salts, for example zinc sulfide and magnesium fluoride and mixtures thereof. Of these materials, preference is given to indium oxide, tin oxide and mixtures thereof and titanium dioxide.

With materials having indices of refraction in the 1.4 to 1.75 range, spacer thicknesses are somewhat thicker. Suitable thicknesses in this embodiment are from about 75 to about 200 nm with thicknesses from about 100 to about 175 nm being preferred. Materials having these indices of refraction include hydrocarbon and oxy-hydrocarbon organic polymers (1.55-1.65 index of refraction) and fluorocarbon polymers (1.35-1.45 index of refraction).

As will be described below, the inorganic metallic and semimetallic oxide dielectrics can be conveniently and preferably deposited by reactive sputtering techniques, although, if desired, chemical deposit and vapor deposition methods can be employed to apply the dielectric layers.

Filter 12 in FIG. 1 is depicted with two boundary layers 20 and 22. These layers provide physical protection to the metal layers beneath them and also serve to reduce visual reflections off of the metal surface to which they are contiguous. It is preferred to have a symmetric sandwich with boundary layers on both outside surfaces. This will give rise to a series of two or more sequential Fabry-Perot interference filters each of the filters comprising a continuous discrete sputter-deposited solar transparent metal layer directly sandwiched between continuous layers of dielectric. This is shown in FIG. 1A.

However, if desired, one or both of the boundary layers can be omitted. This is shown in FIG 1B. The boundary layers can be the same or different dielectric and can be identical to or different than the dielectric making up the spacers. The same preferences of materials recited for the spacer apply to the boundary layers and, for simplicity, it is preferred if the boundary layers and the spacer layers are all made of the same materials and if they are all sputter-deposited.

The thickness of the boundary layers range from about 20 nm to about 150 nm. Boundary layers are preferably from about 25 to about 90 nm and especially from about 30 to about 70 nm in thickness for dielectrics having an index of refraction of from about 1.75 to about 2.25. With materials having indices of refraction in the 1.4 to 1.75 range, preferred thicknesses are from about 30 to about 140 nm and especially from about 45 to about 100 nm. If, as shown in FIG. 2, three or more transparent metal layers are employed, the boundary layers will remain substantially unchanged.

[col. 6] Supporting the Filter

In each of FIGS. 1 through 6, the Fabry-Perot type filter is shown directly adhered to a transparent support 14. This support is shown in section because it is many times as thick as the filter. This thick support is essential to the practice of this invention. The filter itself is at most only a few hundred nanometers thick and thus can have only minimal physical strength without the added support. Support 14 can be selected from among the rigid and nonrigid but minimally stretchable transparent solids

which can withstand the conditions of sputter deposition. Glass, both plate glass and laminated glass, and rigid plastics, such as poly(carbonate) and poly(acrylate) in thicknesses from about 50 mils to about 5 cm or more are representative examples of rigid supports. Poly(ester)s including poly(ethylene terphthalate) and other terphthalate ester polymers, poly(urethanes), cellulose ester polymers, acrylic polymers, and poly(vinyl fluoride)s from about 1 or 2 mils to about 50 mils in thickness are representative examples of nonrigid, minimally stretchable films which may be employed. Poly(esters) and in particular poly(ethylene terphthalates) such as the duPont "Mylars" are a preferred group of film supports.

The filter 12 is directly adhered to the support 14. This can be carried out by sequentially applying the various layers of the filter directly to the support. If the layers are applied by sputter deposition, this can involve first sputter depositing a boundary layer than a transparent metal layer, a spacer layer, etc.

Incorporation into Glazing Structures

As may be seen by referring to FIGS. 3 through 6, the multi-metal layer films of this invention may, if desired, contain a number of optional layers and may be incorporated into a great variety of glazing structures for architectural and transportation system uses. In FIG. 3 a film 30 is shown containing an optional protection layer 32 over filter 12. This layer 32 can typically be a hardcoat, such as a silicon-containing coating which is applied as a liquid and thereafter cured with heat and/or plasma or

corona discharge to yield a hard scratch-resistant overcoating. Typical hardcoats are the cured products resulting from heat or plasma treatment of (a) a hydrolysis and condensation product of methyltriethoxysilane; (b) mixtures of poly(silicic acid) and copolymers of fluorinated monomers with compounds containing primary and secondary alcohol groups as described in U.S. Pat. Nos. 3,429,845 and 3,429,845, respectively. Other hardcoat layers are described in U.S. Pat. Nos. 3,390,203; 3,514,425; and 3,546,318. These hardcoat layers have thicknesses in the range of a few to a few hundred microns.

In FIG. 4, a preferred configuration 40 for employing the films of this invention is depicted. In this embodiment, the filter 12 is deposited on a support 14 as already described. The opposite side of the support 14 carries a previously applied hardcoat 42 for scratch resistance. The filter side of the film is then adhered to a transparent substrate 46 such as another film or a layer or glass or rigid plastic, or the like using an optically acceptable adhesive 44 such as poly(vinyl butyral), ionomer resin, poly(urethane) resin, or polyvinyl chloride resin. Although not wishing to be limited to a particular adhesive, preference is given to the commonly used glass adhesive, poly(vinyl butyral).

[col. 7] The configuration shown in FIG. 4. is of special interest in areas where the polymer film supported filter is applied to the inside surface of a sheet of glass or other rigid material. This can be used as architectural glass, as automotive windshields (when the glass is a suitable tempered or laminated safety glass), automotive side or rear window glass (again with proper tempering, etc), as aircraft canopies, and the like. In these

applications, the plastic support 14 can, if desired, be selected to provide antilacerative properties to the resulting final product, as is disclosed in U.S. Pat. No. 3,900,673 which is incorporated herein by reference both for its teachings of antilacerative coatings and for its teachings of the fabrication of safety glass structures.

Turning to FIG. 5, another embodiment 50 of the invention is depicted in which the film is adhered to a transparent glass substrate 54 with an adhesive 52, this time through the transparent plastic support 14. This embodiment has the disadvantage that the filter 12 is potentially physically accessible so that it can be physically damaged if great care is not taken. This can of course be corrected by placing this surface in the interior of a double pane glass unit, or by providing other suitable protection.

In FIG. 6 yet another embodiment 60 is shown. Window unit 60 contains a sheet of film 10 stretched under tension between glass or plastic panes 62 and 64, 66 and 66′ are air voids and 68 and 68′ are spacer plugs for holding the film in proper position and properly under tension. This general window structure in which the present filters may be used and the materials and methods of its manufacture are shown in U.S. Pat. No. 4,335,166, which is incorporated herein by reference.

An unexpected advantage of the films of the present invention which employ multiple transparent metal layers is their superior efficiency when laminated to a transparent substrate in the configuration shown in FIG. 4.

In this configuration, the multiple transparent metal layer filters of this invention offer special advantages and efficiencies. When a transparent support-backed single metal layer sandwich filter (i.e. an induced transmission filter) is laminated directly to a second sheet of transparent substrate to give a support-filter-substrate configuration, the filter undergoes a drop in efficiency. FIG. 7 illustrates that for a single metal layer filter this drop in efficiency is quite pronounced.

FIG. 7 depicts the transmission and reflectance of visible and infra-red wavelengths by a one metal layer filter with and without lamination to a second transparent layer. In the case shown, this second layer is a second layer of plastic support. By difference, the energy absorbed by this filter with and without lamination is shown as well. Line T is the transmittance curve for the unlaminated film. T*L* is the transmittance curve for the laminated film. R and R*L* are the reflectance curves. A and A*L* are the absorption curves. This filter has a 4 mil poly (ethylene terphthalate) (PET) backing having a directly deposited 46 nm thick tin-indium mixed oxide dielectric boundary layer; an 11.8 nm thick layer of sputter-deposited silver topped with another 46 nm thick tin-indium oxide boundary layer. The layer to which this film is laminated is a second sheet of the PET.

As can be seen, the lamination causes transmittance in the visible region to drop markedly while substantially increasing transmittance of energy in the infra-red region. The Tvis value for the filter drops from 82% to [col. 8] 70% when it is laminated. As the same time Tsol only drops from 62% to 55%. This illustrates that the filter is not preferentially passing visible wavelengths with the

efficiency it did before lamination. This film when laminated provides a Shading Coefficient of 0.67. This is little better than conventional green-tinted glass.

Turning to FIG. 8 comparable curves are presented for a filter of the invention having two metal layers. This filter uses the same materials and the same lamination layer used in the filter characterized in FIG. 7. The filter layers are 35 nm of dielectric, 10.7 nm of silver, 75 nm of dielectric, 10.7 nm of sputter-deposited silver and 40 nm of dielectric. The curves are identified as in FIG. 7. One advantage is clear from the curves. In the infrared region, this filter is much more efficient and does not change appreciably when laminated. When Tvis and Tsol and SC values are determined it is seen that the drop in Tvis is much less pronounced and in fact, relatively less or the same than the drop in Tsol. (Tvis went from 76% to 70%. Tsol went from 45% to 40%.) The SC value for the laminated material is a superior 0.53.

In FIG. 9 the same data are presented for a filter of this invention having three sputter-deposited transparent metal layers. This filter uses the same materials used in the filters characterized in FIGS. 7 and 8 in a 35 nm dielectric/7 nm silver/65 nm dielectric/10 nm silver/70 nm dielectric/9 nm silver/35 nm dielectric structure. With this filter, the drop in Tvis is relatively less than the drop in Tsol so that the efficiency of the filter was substantially unchanged by lamination. (Tvis went from 74% to 70%. Tsol went from 42% to 38%.)

Methods of Preparation

The films of this invention are prepared by laying down a series of uniform continuous layers of metal and dielectric in sequence on a support. The metal layers are laid down using magnetron sputtering. This technique can also be used to lay down the dielectric layers if they are of the inorganic oxide type which is preferred. Importantly, this technique can achieve the desired direct contiguous deposit of the various layers upon one another and upon the support layer without resort to nucleation layers and the like.

This technique and apparatus suitable for carrying out the production of the present materials are both described in detail in U.S. Pat. No. 4,204,942 of Charroudi (May 27, 1980) which for brevity is incorporated herein by reference.

Chemical coating or vapor deposition can be used to deposit the dielectric materials but are not preferred. If these methods are used, conventional techniques of thermal evaporation, electron beam evaporation and chemical vapor deposition and the like known to those of skill in the art will be employed.

Although this invention has been described with reference to certain preferred embodiments, these are not to be construed as limitations upon the invention's scope which is as defined by the following claims:

What is claimed is:

1. In a transparent, infrared reflecting composite film including a transparent metal layer-dielectric layer filter adhered to one side of a transparent support, the

improvement comprising employing as the transparent metal layer-dielectric layer filter a visible light-transmitting infrared-reflecting Fabry-Perot interference filter which includes at lease two separate discrete continuous sputter-deposited transparent metal layers separated from one another by a discrete continuous spacer layer [col. 9] of sputter-deposited inorganic metal oxide, compound or salt dielectric wherein each transparent metal layer is contiguous with the directly adherent to the adjacent spacer layer of dielectric without an intervening nucleation layer.

2. The improved composite film of claim 1 wherein the support is plastic.

3. The improved composite film of claim 2 additionally comprising a protective layer layer adhered to the side of the support which does not have the transparent metal layer-dielectric layer filter adhered thereto.

4. A transparent, infrared reflecting composite film comprising a transparent support having adhered to one surface thereof the first layer of a five layer interference filter each of the five layers comprising a continuous discrete sputter-deposited layer directly contiguous with its adjacent layers, the first, third and fifth layers being dielectric layers and the second and fourth layers being transparent metal layers.

5. A transparent, infrared reflecting composite film comprising a transparent support having adhered to one surface thereof the first layer of a seven layer interference filter each of the seven layers comprising a continuous discrete sputter-deposited layer directly contiguous with its adjacent layers, the first, third, fifth and seventh layers

being dielectric layers and the second, fourth and sixth layers being transparent metal layers.

6. A visually transparent, infrared reflecting composite film comprising a transparent support having adhered to one surface thereof an interference filter comprising two or more continuous discrete sputter-deposited transparent metal layers each of which is directly sandwiched between continuous layers of dielectrics.

7. A process for preparing a transparent, infrared reflecting composite film including a transparent metal layer-dielectric layer Fabry-Perot interference filter adhered to a transparent support comprising the steps of

a. directly sputter depositing upon the transparent support a discrete continuous first outer layer of dielectric,

b. directly sputter depositing upon the first outer layer a discrete continuous first transparent metal layer,

c. directly sputter depositing upon the first transparent metal layer a discrete continuous first spacer layer of dielectric,

d. directly sputter depositing upon the first spacer layer a discrete continuous second transparent metal layer,

e. directly sputter depositing upon the second transparent metal layer a discrete continuous second spacer layer of dielectric,

f. directly sputter depositing upon the second spacer layer a discrete continuous third transparent metal layer, and

g. directly sputter depositing upon the third metal layer a second outer layer of dielectric thereby forming a filter having three discrete metal layers.

8. A visually transparent, infrared reflecting composite film comprising a transparent support having adhered to one surface thereof an interference filter having a plurality of continuous directly contiguous stacked layers, said layers comprising:

a. a dielectric layer,

b. a discrete sputter-deposited transparent metal layer,

c. one or more pairs of layers, each pair comprising a dielectric spacer layer and

[col. 10] a discrete sputter-deposited transparent metal layer, and

d. a dielectric outer layer.

9. The composite film of claim 8 wherein the metal layers each are from 4 to 40 nm in thickness and the dielectric layers each are from 40 to 200 nm in thickness.

10. The composite film of claim 9 wherein the metal layers each comprise metal selected from the group consisting of silver, gold, platinum, palladium, aluminum, copper and nickel and alloys thereof.

11. The composite film of claim 9 wherein the support comprises plastic.

12. The composite film of claim 9 wherein the support comprises glass.

13. The composite film of claim 8 wherein the dielectric is a sputter-deposited dielectric.

14. The composite film of claim 13 wherein the metal layers each comprise silver and each are from 4 to 17 nm in thickness and the dielectric layers each have an index of refraction of from about 1.75 to about 2.25 with the spacer layers having a thickness of from 70 to 100 nm and outer layers having a thickness of from about 30 nm to about 70 nm.

15. The composite film of claim 14 wherein there are two metal layers each from 10 to 12 nm in thickness.

16. The composite film of claim 14 wherein there are three metal layers each from 5 to 10 nm in thickness.

17. The composite film of claim 8 wherein said one or more pairs layers comprise a single pair.

18. The composite film of claim 8 wherein said one or more pairs of layers comprise two pairs.

19. A process of preparing a transparent, infrared reflecting composite film including a transparent metal layer-dielectric layer Fabry-Perot interference filter adhered to a transparent support, comprising the steps of

(a) directly sputter-depositing upon the transparent support a discrete continuous first layer of dielectric,

(b) directly sputter-depositing upon the first layer a discrete continuous first transparent metal layer,

(c) directly sputter-depositing upon the first transparent metal layer a discrete continuous spacer layer of dielectric,

(d) directly sputter-depositing upon the spacer layer a second discrete continuous transparent metal layer, and

(e) directly sputter-depositing upon the second metal layer a second outer layer of dielectric.

20. The process of claim 19 wherein the metal is silver and wherein the transparent support is plastic.

21. A window glazing material product comprising a transparent glass support having directly adhered to one of its surfaces an interference filter comprising two or more continuous discrete sputter-deposited transparent metal layers each of which is directly sandwiched between continuous layers of dielectric.

22. The window glazing material of claim 21 additionally comprising a protection layer located over the interference filter.

23. A window glazing material product comprising a transparent glass sheet substrate having adhered to one side a transparent plastic sheet support, said support having on its side not adhered to the glass sheet substrate in interference filter comprising two or more discrete sputter-deposited transparent metal layers each [col. 11] of which directly sandwiched between continuous layers of dielectric.

24. A window glazing material product comprising a transparent plastic sheet support having adhered to one side an interference filter comprising two or more discrete sputter-deposited transparent metal layers each of which is directly sandwiched between continuous layers

of dielectric, and a transparent glass sheet substrate adhered to said interference filter.

25. A window of glazing material product comprising a pair of sheets of plastic or glass, spaced from each [col. 12] other in parallel alignment to present an internal space between them; and

a visually transparent, infrared reflecting composite film suspended in the internal space in parallel alignment with the glass or plastic sheets, said composite film comprising a transparent plastic sheet support having adhered to one side thereof an interference filter comprising two or more continuous discrete sputterdeposited transparent metal layers each of which is directly sandwiched between continuous layers of dielectric.

* * *

REEXAMINATION CERTIFICATE (1645th)

United States Patent [19] [11] **B1 4,799,745**

Meyer et al. [45] Certificate Issued **Feb. 25, 1992**

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[54] HEAT REFLECTING COMPOSITE FILMS AND GLAZING PRODUCTS CONTAINING THE SAME

[75] Inventors: **Stephen F. Meyer**, Los Altos; **Thomas G. Hood**, San Francisco, both of Calif.

[73] Assignee: **Southwall Technologies, Inc.**, Palo Alto, Calif.

Reexamination Request:

No. 90/002,223, Dec. 6, 1990

Reexamination Certificate for:

Patent No.:	**4,799,745**
Issued:	**Jan. 24, 1989**
Appl. No.:	**880,797**
Filed:	**Jun. 30, 1986**

[51] Int. Cl.[5] **G02B 5/28**

[52] U.S. Cl. **359/360**; 204/192.27; 359/589

[58] **Field of Search** 350/1, 7; 204/192.27

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,649,359	3/1972	Apfel et al.
4,179,181	12/1979	Chang
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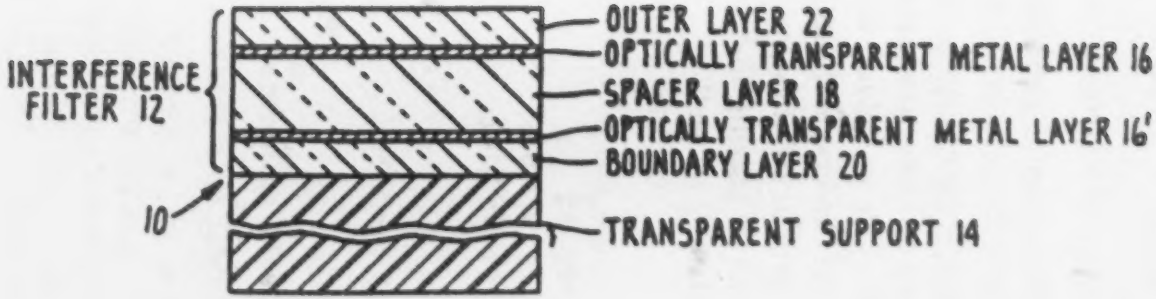
FOREIGN PATENT DOCUMENTS

031278 12/1980 European Pat. Off.

Primary Examiner – Bruce Y. Arnold

[57] **ABSTRACT**

Visually transparent, infra-red reflecting films are disclosed for solar heat control. The films employ Fabry-Perot sandwich interference filters which are characterized by having two or more transparent layers of sputter-deposited metal such as silver directly contiguous with dielectric spacer layers and optionally boundary layers. Methods for producing these materials by sputtering techniques as well as glazing materials incorporating these films are disclosed, as well.


INTERFERENCE FILTER 12
10
OUTER LAYER 22
OPTICALLY TRANSPARENT METAL LAYER 16
SPACER LAYER 18
OPTICALLY TRANSPARENT METAL LAYER 16'
BOUNDARY LAYER 20
TRANSPARENT SUPPORT 14

[col. 1] **REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307**

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been delected and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

The patentability of claim 5 is confirmed.

Claims 1-4, 6-13 and 17-25 are cancelled.

Claim 14 is determined to be patentable as amended.

Claims 15 and 16, dependent on an amended claim, are determined to be patentable.

New claims 26-40 are added and determined to be patentable.

14. [The] *A visually transparent, infrared reflecting* The] composite film [of claim 13] *comprising a transparent support having adhered to one surface thereof an interference filter having a plurality of continuous directly contiguous stacked layers, said layers comprising:*

a. a dielectric layer,

b. A discrete sputter-deposited transparent metal layer,

c. one or more pairs of layers, each pair comprising a dielectric spacer layer and a discrete sputter-deposited transparent metal layer, and

d. a dielectric outer layer,

wherein the dielectric is a sputter-deposited dielectric; the metal layers each comprise silver and each are from 4 to 17 nm in thickness and the dielectric layers each have an index of refraction of from about 1.75 to about 2.25 with the spacer layers having a thickness of from 70 to 100 nm and outer layers having a thickness of from about 30 nm to about 70 nm.

26. In a transparent, infrared-reflecting composite film including a transparent metal layer-dielectric layer filter adhered directly to one side of a transparent support, the improvement comprising employing as the transparent metal layer-dielectric layer filter a visible light-transmitting infrared-reflecting Fabry-Perot interference filter having five layers, wherein each of the five layers is a continuous, discrete sputter-deposited layer directly contiguous with its adjacent layers without an intervening nucleaton layer, the first, third and fifth layers being dielectric layers comprising indium oxide, the first and fifth dielectric layers being from about 30 to about 70 nm thick and said third dielectric layer being from about 70 to about 100 nm thick, each of said dielectric layers having an index of refraction of from about 1.75 to about 2.25, and the second and fourth layers being transparent silver layers from about 4 to about 17 nm in thickness.

27. The improved composite film of claim 26, wherein the transparent support is plastic.

28. The improved composite film of claim 26, wherein the plastic is poly(ethylene terephthalate).

29. In a transparent, infrared-reflecting composite film including a transparent metal layer-dielectric layer filter [col. 2] *adhered directly to one side of a transparent support, the improvement comprising employing as the transparent metal*

layer-dielectric layer filter a visible light-transmitting infrared-reflecting Fabry-Perot interference filter having seven layers, wherein each of the seven layers is a continuous, discrete sputter-deposited layer directly contiguous with its adjacent layers without an intervening nucleation layer, the first, third, fifth and seventh layers being dielectric layers comprising indium oxide, the first and fifth dielectric layers being from about 30 to about 70 nm thick and said third dielectric layer being from about 70 to about 100 nm thick, each of said dielectric layers having an index of refraction of from about 1.75 to about 2.25, and the second, fourth and sixth layers being transparent silver layers from about 4 to about 17 nm in thickness.

30. The improved composite film of claim 29, wherein the transparent support is plastic.

31. The improved composite film of claim 30, wherein the plastic is poly(ethylene terephthalatel).

32. In an infrared-reflecting glazing material comprising a transparent glazing material having an infrared-reflecting film adhered to its surface, the improvement comprising employing as the infrared-reflecting film a transparent plastic support carrying a visible light-transmitting infrared-reflecting Fabry-Perot interference filter having five layers, wherein each of the five layers is a continuous, discrete sputter-deposited layer directly contiguous with its adjacent layers without an intervening nucleation layer, the first, third and fifth layers being dielectric layers comprising indium oxide, the first and fifth dielectric layers being from about 30 to about 70 nm thick and said third dielectric layer being from about 70 to about 100 nm thick, each of said dielectric layers having an index of refraction of from about 1.75 to about 2.25, and the second and

fourth layers beings transparent silver layers about 4 to about 17 nm in thickness.

33. *In an infrared-reflecting glazing material comprising a transparent glazing material having an infrared-reflecting film adhered to its surface, the improvement comprising imploying as the infrared reflecting film a transparent plastic support carrying a visible light-transmitting infrared-reflecting Fabry-Perot interference filter having seven layers, wherein each of the seven layers is a continuous, discrete sputter-deposited layer directly contiguous with its adjacent layers without an intervening nucleaton layer, the first, third, fifth and seventh layers being dialectic layers comprising indium oxide, the first and fifth dielectric layers being from about 30 to about 70 nm thick and said third dielectric layer being from about 70 to about 100 nm thick, each of said dielectric layers having an index of refraction of from about 1.75 to about 2.25, and the second, fourth and sixth layers being transparent silver layers from about 4 to about 17 nm in thickness.*

34. *In an infrared-reflecting glazing material comprising a transparent glazing material having an infrared-reflecting film adhered to its surface the improvement comprising employing as the infrared reflecting film a visible light-transmitting infrared-reflecting Fabry-Perot interference filter having five layers, wherein each of the five layers is a continuous, discrete sputter-deposited layer directly contiguous with its adjacent layers without an intervening nucleation layer, the first, third and fifth layers being dielectric layers comprising indium oxide, the first and fifth dielectric layers being from about 30 to about 70 nm thick and said third dielectric layer being from abut 70 to about 100 nm thick, each of said dielectric layers having an index of refraction of from about 1.75 to about* [col. 3] *2.25, and the second and fourth layers*

being transparent silver layers from about 4 to about 17 nm in thickness.

35. In an infrared-reflecting glazing material comprising a transparent glazing material having an infrared-reflecting film adhered to its surface the improvement comprising employing as the infrared reflecting film a visible light-transmitting infrared-reflecting Fabry-Perot interference filter having seven layers, wherein each of the seven layers is a continuous, discrete sputter-deposited layer directly contiguous with its adjacent layers without an intervening nucleation layer, the first, third, fifth and seventh layers being dielectric layers comprising indium oxide, the first and fifth dielectric layers being from about 30 to about 70 nm thick and said third dielectric layer being from about 70 to abut 100 nm thick, each of said dielectric layers having an index of refraction of from about 1.75 to about 2.25, and the second, fourth and sixth layers being transparent silver layers from about 4 to about 17 nm in thickness.

36. A visually transparent, infrared reflecting composite film comprising a transparent support having adhered to one surface thereof an interference filter having a plurality of continuous directly contiguous stacked layers, said layers comprising:

a. a dielectric layer,

[col. 4] *b. A discrete sputter-deposited transparent metal layer,*

c. one or more pairs of layers, each pair comprising a dielectric spacer layer and a discrete sputter-deposited transparent metal layer, and

d. a dielectric outer layer,

wherein the dielectric is a sputter-deposited dielectric; the metal layers each comprise silver and each are from 4 to 17 nm in thickness and the dielectric layers each have an index of refraction of from about 1.75 to about 2.25 with the spacer layers having a thickness of from 50 to 110 nm and outer layers having a thickness of from about 30 nm to about 70 nm.

37. The visually transparent infrared reflecting composite film of claim 36 wherein (c.) said one or more pairs of layers is one pair of layers.

38. The visually transparent infrared reflecting composite film of claim 37 wherein the metal layers are from 10 to 12 nm in thickness.

39. The visually transparent infrared reflecting composite film of claim 36 wherein in (c.) said one or more pairs of layers is two pairs of layers.

40. The visually transparent infrared reflecting composite film of claim 39 wherein the metal layers are from 5 to 10 nm in thickness.

* * *

WHAT IS CLAIMED IS:

1. In a transparent, infrared reflecting composite film including a transparent metal layer-dielectric layer filter adhered to a transparent support, the improvement comprising employing as the filter a Fabry-Perot interference filter made up of a multilayer stack including at least two separate discrete continuous sputter-deposited transparent metal layers separated from one another by discrete continuous layers of dielectric.

2. The improved composite film of claim 1 wherein the multilayer stack additionally comprises a separate and discrete continuous boundary layer of dielectric.

3. The improved composite film of claim 1 wherein the multilayer stack additionally comprises two separate and discrete continuous boundary layers of dielectric.

4. The improved composite film of claim 1 wherein in the multilayer stack, the transparent metal layers are contiguous with and directly adherent to the dielectric layers without intervening nucleation layers.

5. The improved composite film of claim 4 wherein the dielectric layers are sputter-deposited.

6. The improved composite film of claim 4 wherein the support is plastic.

7. The improved composite film of claim 6 additionally comprising a hard coat layer adhered to the side of the support which does not have the filter adhered thereto.

8. A transparent, infrared reflecting composite film comprising a transparent support having adhered to one

surface thereof the first layer of a five layer interference filter each of the five layers comprising a continuous discrete sputter-deposited layer directly contiguous with its adjacent layers, the first, third and fifth layers being dielectric layers and the second and fourth layers being transparent metal layers.

9. A transparent, infrared reflecting composite film comprising a transparent support having adhered to one surface thereof the first layer of a seven layer interference filter each of the seven layers comprising a continuous discrete sputter-deposited layer directly contiguous with its adjacent layers, the first, third, fifth and seventh layers being dielectric layers and the second, fourth and sixth layers being transparent metal layers.

10. A visually transparent, infrared reflecting composite film comprising a transparent support having adhered to one surface thereof two of more sequential interference filters each of the filters comprising a continuous discrete sputter-deposited transparent metal layer directly sandwiched between continuous spacer layers of dielectric.

11. The composite film of claim 10 wherein the two or more sequential interference filters are contiguous such that the dielectric spacer layers intermediate the metal layers become single layers of dielectric.

12. The composite film of claim 11 containing two sequential interference filters.

13. The composite film of claim 11 containing three sequential interference filters.

14. The composite film of claim 11 wherein the metal layers each are from 4 to 40 nm in thickness and the dielectric layers each are from 40 to 200 nm in thickness.

15. The composite film of claim 14 wherein the metal layers each comprise metal selected from the group consisting of silver, gold, platinum, palladium, aluminum, copper and nickel and alloys thereof.

16. The composite film of claim 13 wherein the dielectric is a sputter-deposited dielectric.

17. The composite film of claim 16, additionally comprising one or two boundary layers of dielectric.

18. The composite film of claim 14 wherein the support comprises plastic.

19. The composite film of claim 14 wherein the support comprises glass.

20. The composite film of claim 17 wherein the metal layers each comprise silver and each are from 4 to 17 nm in thickness and the dielectric layers each have an index of refraction of from about 1.75 to about 2.25 with spacer layers having a thickness of from 70 to 100 nm and boundary layers having a thickness of from about 30 nm to about 70 nm.

21. The composite film of claim 20 wherein there are two metal layers each from 10 to 12 nm in thickness.

22. The composite film of claim 20 wherein there are three metal layers each from 5 to 10 nm in thickness.

23. A process for preparing a transparent, infrared reflecting composite film including a transparent metal

layer-dielectric layer Fabry-Perot interference filter adhered to a transparent support, comprising the steps of

a directly sputter-depositing upon the transparent support a discrete continuous first boundary layer of dielectric.

b directly sputter-depositing upon the first boundary layer a discrete continuous first transparent metal layer.

c directly sputter-depositing upon the first transparent metal layer a discrete continuous spacer layer of dielectric.

d directly sputter-depositing upon the spacer layer a second discrete continuous transparent metal layer, and

e directly sputter-depositing upon the second metal layer a second boundary layer of dielectric.

24. The process of claim 23 comprising the additional steps of repeating steps c and d thereby forming a filter having three discrete metal layers.

25. The process of claim 23 wherein the metal is silver and wherein the transparent support is plastic.

26. A window glazing material product comprising the composite of claim 10 wherein the transparent support is glass and wherein the two or more sequential interference filters are directly adhered to the surface of the glass.

27. The window glazing material of claim 26 additionally comprising a hardcoat layer located over the two or more sequential interference filters.

28. A window glazing material product comprising the composite of claim 10 wherein the transparent support is plastic sheet, wherein the two or more sequential interference filters are directly adhered to the surface of the plastic and wherein the composite film is adhered to a transparent substate comprising glass.

29. The glazing material of claim 28 wherein the plastic sheet is adhered to the transparent substrate.

30. The glazing material of claim 28 wherein the interference filters are adhered to the transparent substrate.

31. The glazing material of claim 29 wherein the plastic sheet of the composite is overlayered with a hardcoat layer.

32. A window glazing material product comprising the composite of claim 10 wherein the transparent support is plastic sheet, wherein the two or more sequential interference filters are directly adhered to the surface of the plastic and wherein the composite film is suspended between two parallel sheets of plastic or glass.

[p. 2] Serial No. 880,797

Art Unit 257

As discussed in the telephone interview the final rejection is withdrawn in order to apply newly discovered art to the claims, in order to question the meaning of "directly deposited" in certain of the claims, to point out

that certain claims inadvertently fail to contain such limitation despite the limitation being the basis argued by applicant to distinguish over Apfel et al, and to clarify some other indefiniteness in certain of the claims as detailed below.

Applicant's attorney is reminded to submit a photocopy of paper No 12 as agreed in the telephone interview.

The drawings are objected to because the invention claimed in claim 4 is not yet illustrated. Also, in Fig 4, "hard coat" should be changed to – protective layer – Correction is required.

Claims 4, 6-10, 14-16, 18-27, 33-36 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 4; at lines 5-6 made . . . including" should be changed to – which includes; at line 9" in . . . stack, should be deleted. (Both changes are needed since, as used in the art, "stack" refers to repetitive layers). In claim 7 "hard coat" should be – protective – (A similar change should be made to the specification). In claims 8-10, 23, 36, 38, and 39 it is unclear what is meant by "directly". Clarification is requested. In claim [p. 3] 33, as agreed in the telephone interview, "directly" was inadvertently omitted and should be inserted. In claim 23, lines 7 and 10, "outer" should be deleted.

In claim 39 line 5 "the glass" should be – the glass or plastic –.

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

The specification is objected to under 35 U.S.C. 112, first paragraph, as failing to provide a written description of the invention.

the specification should describe item "14" as being plastic and item "54" as being glass as claimed in claim 36 (see specification at p.13). Also, glass at page 14 line 5 should be "glass or plastic" to provide written description for claim

Claims 36 and 39 are rejected under 35 U.S.C. 112, first paragraph, for the reasons set forth in the above objection to the specification.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for [p. 4] patent in the United States.

Claims 4, 6-10, 14-16, 18-27, 33-36, are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103 as obvious over Franz.

Franz teaches employing alternate layers of metal/metal oxide to a transparent substrate such as glass or plastic and the use of a protective layer to make a transparent heat reflecting window (see col. 2 lines 48-67, the sentence bridging columns 2 and 3, and col. 6, lines 39-45). Although the preferred embodiment of just two layers would not comprise a Fabry-Perot filter, Franz teaches that "more than two layers may be employed", see col. 2, lines 57-60 and such embodiments would comprise a Fabry Perot filter. The metal layers lie in the range of 2-100 mm thickness and the metal oxide layers are 5-150 mm in thickness, see col. 3, lines 12-17. The metal layer is sputter deposited and the metal oxide layer is sputter deposited as a metal and then oxidized, see col. 4, lines 25-28. It is unclear whether the "metal oxide is sputter-deposited" limitation is meant to encompass the situation where the metal oxide is putter deposited as a metal and later oxidized. Until clarification, the examiner most interpret the claims broadly. Silver, nickle, or alloys therof may comprise the metal layer (col. 2 lines 35-47). Lacking unexpected results from having 5 or 7 layers, it would appear that one of ordinary skill would find it a matter [p. 5] of design choice to select a given number of layers. Likewise lacking an unobvious result form having a particular thickness outer (protective) layer as claimed in claim 20, this would appear to be a matter of mere design choice. Similarly, since Franz teaches two windows in a frame (Fig 4) with the heat reflecting film (which may comprise additional layers than shown and

thus inherently would then be "an interference filter") those of ordinary skill would have found it an obvious alternative in the case where the filter substrate is plastic, to suspend the plastic between the glass panes. Thus, claims 4, 6-10, 14-16, 18-27, 33-36, are rejected.

Yatabe et al is cited as of interest and possibly relevant. It is requested that applicant's attorney review Yatabe et al before formulating a response to the office action.

Any inquiry concerning this communication should be directed to Examiner Arnold at telephone number 703-557-3083.

Arnold/rk

7/5/88

/s/ Bruce Y. Arnold
BRUCE Y. ARNOLD
EXAMINER
GROUP ART UNIT 257

Atty Dkt 8200-0005
PATENT

IN THE UNITED STATES PATENT
AND TRADEMARK OFFICE

In Re Application of:

Stephen F. Meyer, et al.

Serial No.: 880,797 Group Art Unit: 257

Filed: 30 June 1986 Examiner: B. Arnold

For: HEAT REFLECTING COMPOSITE FILMS AND GLAZING PRODUCTS CONTAINING THE SAME

AMENDMENT PURSUANT TO 37 CFR 1.111

(Received Aug. 19 1988)

The Honorable Commissioner of
Patents and Trademarks
Washington, D.C. 20231

Sir:

This amendment is responsive to the Office Action dated July 8, 1988 in this application. The Office Action under reply is the 14th paper entered into this file and served to reopen prosecution after an involved series of Office Actions, responses and telephonic interviews had been carried out and were believed to have placed the application in condition for allowance.

Please amend this application as follows:

In the Drawings

Please replace the drawings presently in the application with the enclosed new set of formal drawings. These new drawings differ from the drawings now on file in the following particulars:

a) they include Fig. 1B which was requested in the Office Action under reply;

[p. 2] b) Fig. 4 has item 42 identified as a – protective layer – rather than as a "hardcoat", this change also being requested in the last Office Action; and

c) the various layers have been "rehatched" to more precisely conform with conventions for the representation of metal layers, plastic layers, and the like. This final change was also expressly requested by the Examiner.

In the Specification

At page 4, line 30, after the semicolon insert the following:

– Fig. 1A is a schematic cross-sectional view of a heat reflecting film of this invention having two metal layers separated by a double spacer layer;

Fig. 1B is a schematic cross-sectional view of a very simple heat reflecting film of this invention having two metal layers separated by a double spacer layer and not including one or more outer or boundary layers; –

At page 10, line 18 after "dielectric," add the sentence – This is shown in Fig. 1A. –

At page 10, line 20 after "omitted." add the sentence – This is shown in Fig. 1B –

At page 12, line 10 correct the spelling of "multi metal" to – multi-metal –

At page 13, line 28, after "transparent" insert – glass – and at page 13, line 29, after "transparent" insert – plastic –

At page 14, line 5, after "glass" insert – or plastic –

In the Claims

Please amend claim 4 as follows:

4. (Thrice amended) In a transparent, infrared reflecting composite film including a transparent metal layer-dielectric layer filter adhered to one side of a transparent support, the improvement comprising employing as the transparent metal layer-dielectric layer filter a visible light-transmitting infrared-reflecting Fabry-Perot interference filter which includes [made up [p. 3] of a multilayer stack including] at least two separate discrete continuous sputter-deposited transparent metal layers separated from one another by a discrete continuous spacer layer of sputter-deposited inorganic metal oxide, compound or salt dielectric wherein [in the multilayer stack,] each transparent metal layer is contiguous with and directly adherent to the adjacent spacer layer of dielectric without an intervening nucleation layer.

Please amend claim 7 by changing "hard coat" in line 2 to – protective layer –

Please amend claim 23 by deleting "outer" from each of lines 7 and 10.

Please amend claim 33 as follows:

33. (Twice amended) A visually transparent, infrared reflecting composite film comprising a transparent support having adhered to one surface thereof an interference filter having a plurality of continuous directly contiguous stacked layers, said layers comprising:

a. a dielectric [outer] layer,

b. a discrete sputter-deposited transparent metal layer,

c. one or more pairs of layers, each pair comprising a dielectric spacer layer and a discrete sputter-deposited transparent metal layer, and

d. a dielectric outer layer.

In claim 39, at line 5, change "the glass" to – glass or plastic –.

Remarks

Reconsideration of this application in light of the above amendments and the following remarks is respectfully requested. Applicants' attorney appreciates the Examiner's care with regard [p. 4] to this application. This is an important case to his client, Southwall Technologies, and its allowance was expected in early July. It is a disappointment that is has been reopened. None the less, it is always good to have all the possible references in the art of record in a patent and to have all matters of form and scope dealt with as clearly and concisely as possible

so as to attain the strongest possible final product. With those thoughts in mind, Applicants have amended the application in light of the new issues raised in the Office Action and the Examiner's helpful comments and submit that now the case should be passed to allowance.

The telephonic interview: The record of telephonic interview has been reviewed and is considered to be correct. Applicants' attorney's notes showed that the Examiner asked for the word "outer" to be deleted from subsection "a." of claim 33. This was not noted in the Office Action but has been carried out.

Paper 12: The copy of Paper 12, which is presently lost from or hiding in the PTO files, is now supplied.

The amendments to the drawing: As noted above, three changes have been made to the drawings. In Fig. 4, item 42 has been renamed a "protective layer" exactly as requested. Similarly, Fig. 1B has now been supplied in direct response to the Office Action's request that a figure depicting the invention of claim 4 be added. Finally, all of the figures previously submitted have been redrawn with hatching to more closely follow the informal convention on hatching of "metal" layers, "plastic" layers and the like. This too was specifically requested by the Examiner. The first and second of these changes find full support in the specification and claims of the application as filed and thus pose no "new matter" issues. Similarly, the rehatching is merely done to make the drawings more closely parallel the words in the specification as filed.

[p. 5] The amendments to the specification: Three types of amendments have been made to the specification:

At page 12, line 10 a typographical error has been corrected.

At page 4 and page 12 brief references to the two figures (Figs. 1A and 1B) added during prosecution are added. As an aside, it does not appear to the undersigned that this was previously done when Fig. 1A was inserted. If that is incorrect any duplication should be removed by Examiner's amendment.

At pages 13 and 14 words are added exactly as expressly requested by the Examiner to achieve closer correspondence between the specification and claims.

The 35 USC 112 rejections and amendments to the claims: The amendments sought to claims 4 and 7 have been made expressly as set forth in the Office Action under reply. The Office Action also requested clarification of the term "directly" as used in claims 8-10, 23, 36, 38, and 39. By the present amendment, claim 33 now recites the term "directly" and thus should also fall within this group. The term "directly" as used in the claims is intended to mean that the layers are present or laid down contiguous with one another without intervening layers. In other words, no nucleation layers are present between two "directly contiguous" layers or between layers which are laid down "directly" on one another. In the telephone interview, Applicants' attorney agreed to make such a clarifying statement of record and the Examiner indicated that such clarification on the record would obviate the rejection based on the use of the word "directly". The amendments to claims 23 and 39 have been made expressly as requested.

These amendments to the claims, coupled with the amendments to the specification are believed to obviate the various form and scope rejections and objections made in the Office Action under reply.

[p. 6] The Art Rejection:

A new reference has been found and entered in this application as the basis for a 35 USC 102 rejection of all the claims outstanding in this application. This rejection is respectfully traversed.

The new reference now applied is USP 3,846,152 of Franz. A second patent, USP 4,639,069, of Yatabe, et al (Yatabe) was called to applicants' attention in the Office Action but not applied against the claims. For the sake of a complete record, this reference will be discussed and it will be shown that the present claims distinguish over its disclosure as well. At the outset, it is respectfully submitted that the newly cited Franz and Yatabe patents appear to be somewhat less in point than at least USP 3,682,528 of Apfel et al which was noted and discussed on page 2 of the specification. It is believed that the claims as last presented distinguished patentably over the Franz and Yatabe disclosure but to provide yet additional clear bases for distinction the claims have been amended to specify that the dielectric layer is laid down as a sputter-deposited inorganic metal oxide, compound or salt. As pointed out in the specification such layers can be laid down directly by reactive sputtering processes in which the metal is sputtered off of a metal target and directly converted to the oxide, compound or salt by the presence of a suitable gaseous reactant. The claims have also been

amended to point out that the Fabry-Perot interference filter which they require reflects infrared and transmits visible light. These features clearly set the present claims apart from these two new references.

The Franz reference really relates in its focus to a two-layer filter made up of one layer of metal and one layer of nonmetal. There is a mention that " . . . the number of metal and metal oxide layers can be increased for particular effect." (col 6, line 40-42) At col 6, line 40, the Franz patent states that its Fig. 3 shows this. A close review of Fig. 3 of the Franz patent shows that this figure does not show multiple metal layers but rather shows the addition of a protective overlayer 9 to a [p. 7] single pair of metal-metal oxide layers. To the undersigned, the Franz patent appears to stand for the proposition that a pair of layers – one metal and one metal oxide – will function as a wavelength-selective filter and that if one wished to, one could use multiple sets of these layers essentially to get an additive effect. To the undersigned, this "additive effect" is much the same as one might achieve by placing two differently colored "gelatins" in front of a theater spotlight to get an addition of their two tints. The undersigned can not find a teaching in the Franz document with states that the two sequential filters would interact such that the two successive metal layers and intervening oxide layer would give rise to a Fabry-Perot interference filter. In other words, the present claims call for a filter in which two metal layers and a dielectric layer interact to give rise to the filtering properties. The Franz reference does not suggest this. If the Examiner can point to any specific teaching in the Franz

reference which he feels are contrary to the above analysis please make them of record. We do not want to mischaracterize this reference but on its face it just does not appear to show what is presently being claimed. To further emphasize the distinctions between the present invention and the Franz reference, it should be noted that Franz obtains his metal oxide layers by depositing a metal layer and then chemically converting it to the desired oxide.

With reference to the Yatabe patent, it should be emphasized that this reference used high refractive index organic layers as its dielectric layers while the present claims call for inorganic metal oxides, salts and the like as their dielectrics.

[p. 8] Conclusion

These amendments and remarks are believed to now place this case in condition for immediate allowance. Such action is earnestly solicited.

Respectfully submitted,
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[SEAL]

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

Address: COMMISSIONER OF PATENTS AND TRADEMARKS
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REEXAM CONTROL NO. 90/002.223

FILING DATE 12/06/90

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ATTORNEY DOCKET NO. 8200-0005.30

EXAMINER RYAN, J

ART UNIT 257

PAPER NUMBER 6

DATE MAILED: 08/05/91

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545 MIDDLEFIELD RD., STE. 200
MENLO PARK, CA 94025

This is a communication from the examiner in charge of this reexamination.

COMMISSIONER OF PATENTS AND TRADEMARKS

___ Responsive to the communication(s) filed on ___.
___ This action is made final.

A shortened statutory period for response to this action is set to expire 2 month(s) ___ days from the date of this letter. Failure to respond within the period for response will cause termination of the proceeding and issuance of a reexamination certificate in accordance with this action.

Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

1. ___ Notice of References Cited by Examiner, PTO-892
2. ___ Notice of Informal Patent Drawing, PTO-948
3. X Notice of References Cited, PTO-1449
4. ___ _____ .

Part II SUMMARY OF ACTION:

1. X Claims 1-37 are subject to reexamination.
2. ___ Claims _____ have been cancelled.
3. ___ Claims _____ are confirmed.
4. X Claims 5, 26-35 are allowed.
5. X Claims 1-4, 6-13, 17-25, 36, 37 are rejected.
6. X Claims 14-16 are objected to.
7. ___ The formal drawings filed on ___ are acceptable.
8. ___ The drawing correction request filed on _____ has been ___ approved. ___ disapproved.
9. ___ Acknowledgement is made of the claim for priority under 35 U.S.C. § 119. The certified copy has ___ been received. ___ not been received. ___ been filed in parent application, Serial Number _____ filed on _____.
10. ___ Since this proceeding appears to be in condition for issuance of a reexamination certificate except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 435 O.G. 213.
11. ___ Other

_____

[p. 2] Reexam, No. 90/002,223

Art Unit 257

The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 4, 6, 8, 17 and 18 are rejected under 35 U.S.C. § 102(b) as being anticipated by Chang.

Chang teaches a transparent, infrared reflecting film, similar to that taught by the patent owner, including a transparent metal layer-dielectric layer of the Fabry-Perot interference filter type, including at least two metal layers separated by a discrete layer of inorganic metal oxide. The details of "sputter-depositing" are irrelevant since such are process steps which don't limit the article itself. The patent owner correctly notes that Chang states that it may be required to use an adhesion-promoting layer, the absence of which thus constituting the distinguishing feature of the present invention. However, patent owner should observe that Chang does not preclude such embodiments without the adhesion-promoting layer. Chang teaches that such a layer is used to promote adhesion to a plastic support substrate, a limitation which the patent owner adds in claim 2. Therefore, the patent owner's claim 1 may [p. 3] include a glass substrate, thus failing to distinguish over the Chang reference.

In claim 4, patent owner limits the invention to a five-layer structure of alternating metal/dielectric layers. Chang teaches his layers as dielectric/metal/dielectric/dielectric/dielectric/metal/dielectric. It is submitted that Chang's device is equivalent to claim 4 since the innermost adjacent dielectric layers simply amount to being one thick layer of dielectric, and thus claim 4 reads on Chang.

Claims 6 and 8 recite the layer structure even more broadly not limiting the number of metal layers. Thus, these claims also read on Chang. Claims 17 and 18 each "comprise" pairs of metal and dielectric layers. Since "comprise" is open language, it is clear that these claims are not limited to one or two pairs and thus Chang (who teaches two pairs) again satisfies the claims.

The following is a quotation of 35 U.S.C. § 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.
>
> Patentability shall not be negatived by the manner in which the invention was made.
>
> [p. 4] Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title,

> shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

Claims 21-25 are rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103 as obvious over Chang.

Chang does not teach his filter for use with any specific application. However, a well known use such as window glazing would be inherent or at least obvious, as intended by Chang. Thus the limitations of claims 21-25 are unpatentable insofar as they follow under arguments set forth previously as applied to window glazing.

Claims 1, 2, 6-13, 17-21, 36 and 37 are rejected under 35 U.S.C. § 102(b) as being anticipated by Farges.

The patent owner argues that Farges teaches away from the claims of the present invention since there are disclosed differences in intended use between Farges and the present invention. All disclosed differences notwithstanding, it is clear that the herein rejected claims do not point to the differences. In claim 1, the language "includes at least two" suggests that the claims are not limited to the elements which follow. It is well settled that "includes" is open language as is "comprising". See e.g., Ex Parte Russell, 153 USPQ 752 (1966). [p. 5] Thus, in addition to the fact that Farges teaches a sputter-deposited metal/dielectric arrangement, deposited upon either glass or plastic substrates, using the identical materials (i.e. silver and indium oxide), and having layer thicknesses within the boundaries of the present invention, it

is clear that Farges teaches a device which satisfies the requirements of claims 1, 2, 6, 8-13, 17 and 18.

Farges teaches sputtering steps which read on claims 7, 19, 20, 36 and 37. Since sputtering is a commonly known process, it is clear that Applicant's broadly recited steps are satisfied by Farges and are thus unpatentable.

Claim 3 is rejected under 35 U.S.C. § 103 as being unpatentable over Farges in view of Chang.

It is extremely well known to apply protective coatings to delicate thin film structures. In fact, Chang himself teaches the desirability in using such a coating for lenses and goggles (Chang, col. 1, lines 46-49). Thus, such use for Farges, who teaches goggles, would clearly have been obvious.

Claims 21-25 are rejected under 35 U.S.C. § 103 as being unpatentable over Farges.

It is admitted that Farges teaches his filter for use with goggles. However, such filters are extremely well known for having a wide variety of applications, not the least of which is window glazing, as is the requirement of claims 21-25. One of [p. 6] ordinary skill would have found it obvious to use Farges' filter for window glazing since it would have totally suppressed the desired wavelength, and, as patent owner admits, would have attenuated the other wavelengths thus permitting only 10% transmittance. This would be desirable for applications where windows have southern exposure, thus admitting undesirable levels of visible sun light.

Claim 5 is allowable. In this claim, the film layers are limited to specific numbers, thus precluding any film stacks with more or less layers.

Claims 14-16 are objected to and 26-35 are allowable since they recite specific values for film thicknesses. Since the effects of varying film thickness for respective layers cannot be reliably predicted, such variations cannot be done without undue experimentation, which would amount to reconstructing the invention.

The remaining references of record, Gillery et al, Yamamoto, Fan et al, and Apfel et al, all teach details which are relevant to the state of the art. However, it is clear from inspection that these references are sufficiently lacking in the specific structure recited in the claims herein. The Examiner more or less agrees with the patent owner's assessment of these references, namely, that while they may be relevant to the disclosure, the claims remain novel and unobvious thereover. [p 7] An updated search of the prior art has failed to reveal any additional better prior art than that uncovered herein.

The patent owner is required to resubmit new claims 26-37 so that they are completely underlined pursuant to 37 CFR 1.121(f), as is expounded in MPEP 2250.

In order to ensure full consideration of any amendments, affidavits or declarations, or other documents as evidence of patentability, such documents **must** be submitted in response to this Office action. Submissions after the next Office action, which is intended to be a final action, will be governed by the requirements of 37 C.F.R. § 1.116, which will be strictly enforced.

Any inquiry concerning this communication should be directed to Examiner Ryan at telephone number (703) 308-1568.

/s/ Edward P. Westin
EDWARD P. WESTIN
EXAMINER
GROUP ART UNIT 259

Ryan/EW
August 01, 1991

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Atty Dkt 8200-0005.30
PATENT

[p. 1] IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re: U.S. Reexamination No. 90/002,223 of U.S. Patent No. 4,799,745

Inventors: Stephen F. Meyer and Thomas G. Hood — Group Art Unit: 257

Issue Date: 24 January 1989 — Examiner: Ryan

Reexamination Filing Date: 06 December 1990

Title: HEAT REFLECTING COMPOSITE FILMS AND GLAZING PRODUCTS CONTAINING THE SAME

AMENDMENT FOLLOWING EXAMINER'S FIRST OFFICE ACTION

(Received Oct. 8, 1991)

The Honorable Commissioner of
Patents and Trademarks
Washington, D.C. 20231

Dear Sir:

This amendment is responsive to the Office Action outstanding in this Reexamination.

Amendments

Please amend the claims in this application as follows:

Please cancel claims 1-4, 6-13, 17-25, 36 and 37.

Please amend claim 14 to read as follows:

14. (Amended) A visually transparent, infrared reflecting [The] composite film [of claim 13] comprising a [p. 2] transparent support having adhered to one surface thereof an interference filter having a plurality of continuous directly contiguous stacked layers, said layers comprising:

a. a dielectric layer.

b. a discrete sputter-deposited transparent metal layer.

c. one or more pairs of layers, each pair comprising a dielectric spacer layer and a discrete sputter-deposited transparent metal layer, and

d. a dielectric outer layer.

wherein the dielectric is a sputter-deposited dielectric; the metal layers each comprise silver and each are from 4 to 17 nm in thickness and the dielectric layers each have an index of refraction of from about 1.75 to about 2.25 with the spacer layers having a thickness of from 70 to 100 nm and outer layers having a thickness of from about 30 nm to about 70 nm.

Please delete the non-underlined version of claims 26-35 previously submitted and add the following underlined version of claims 26-35:

–26. In a transparent, infrared-reflecting composite film including a transparent metal layer-dielectric layer filter adhered directly to one side of a transparent support, the improvement comprising employing as the transparent metal layer-dielectric layer filter a visible light-transmitting infrared-reflecting Fabry-Perot interference filter having five layers, wherein each of the five layers is a continuous, discrete sputter-deposited layer directly contiguous with its adjacent layers without an intervening nucleation layer, the first, third and fifth layers being dielectric layers comprising indium oxide, the first and fifth dielectric layers being from about 30 to about 70 nm thick and said third dielectric layer being from [p. 3] about 70 to about 100 nm thick, each of said dielectric layers having an index of refraction of from about 1.75 to about 2.25, and the second and fourth layers being transparent silver layers from about 4 to about 17 nm in thickness.

27. The improved composite film of claim 26, wherein the transparent support is plastic.

28. The improved composite film of claim 26, wherein the plastic is poly(ethylene terephthalate).

29. In a transparent, infrared-reflecting composite film including a transparent metal layer-dielectric layer filter adhered directly to one side of a transparent support, the improvement comprising employing as the transparent metal layer-dielectric layer filter a visible light-transmitting infrared-reflecting Fabry-Perot interference filter having seven layers, wherein each of the seven layers is a continuous, discrete sputter-deposited layer directly contiguous with its adjacent layers without an intervening nucleation layer, the first, third, fifth and seventh layers being dielectric layers comprising indium oxide, the first and fifth dielectric layers being from about 30 to about 70 nm thick and said third dielectric layer being from about 70 to about 100 nm thick, each of said dielectric layers having an index of refraction of from about 1.75 to about 2.25, and the second, fourth and sixth layers being transparent silver layers from about 4 to about 17 nm in thickness.

30. The improved composite film of claim 29, wherein the transparent support is plastic.

[p. 4] 31. The improved composite film of claim 30, wherein the plastic is poly(ethylene terephthalate).

32. In an infrared-reflecting glazing material comprising a transparent glazing material having an infrared-reflecting film adhered to its surface, the improvement comprising employing as the infrared-reflecting film a transparent plastic support carrying a visible light-transmitting infrared-reflecting Fabry-Perot interference filter having five layers, wherein each of the five layers is a

continuous, discrete sputter-deposited layer directly contiguous with its adjacent layers without an intervening nucleation layer, the first, third and fifth layers being dielectric layers comprising indium oxide, the first and fifth dielectric layers being from about 30 to about 70 nm thick and said third dielectric layer being from about 70 to about 100 nm thick, each of said dielectric layers having an index of refraction of from about 1.75 to about 2.25, and the second and fourth layers being transparent silver layers about 4 to about 17 nm in thickness.

33. In an infrared-reflecting glazing material comprising a transparent glazing material having an infrared-reflecting film adhered to its surface, the improvement comprising employing as the infrared-reflecting film a transparent plastic support carrying a visible light-transmitting infrared-reflecting Fabry-Perot interference filter having seven layers, wherein each of the seven layers is a continuous, discrete sputter-deposited layer directly contiguous with its adjacent layers without an intervening nucleation layer, the first, third, fifth and seventh layers being dielectric layers comprising indium oxide, the first and fifth dielectric layers being from about 30 to about 70 nm thick and said third dielectric layer being from about 70 to about 100 nm thick, each of said dielectric layers having [p. 5] an index of refraction of from about 1.75 to about 2.25, and the second, fourth and sixth layers being transparent silver layers from about 4 to about 17 nm in thickness.

34. In an infrared-reflecting glazing material comprising a transparent glazing material having an infrared-reflecting film adhered to its surface the improvement comprising employing as the infrared-reflecting film a

visible light-transmitting infrared-reflecting Fabry-Perot interference filter having five layers, wherein each of the five layers is a continuous, discrete sputter-deposited layer directly contiguous with its adjacent layers without an intervening nucleation layer, the first, third and fifth layers being dielectric layers comprising indium oxide, the first and fifth dielectric layers being from about 30 to about 70 nm thick and said third dielectric layer being from about 70 to about 100 nm thick, each of said dielectric layers having an index of refraction of from about 1.75 to about 2.25, and the second and fourth layers being transparent silver layers from about 4 to about 17 nm in thickness.

35. In an infrared-reflecting glazing material comprising a transparent glazing material having an infrared-reflecting film adhered to its surface the improvement comprising employing as the infrared-reflecting film a visible light-transmitting infrared-reflecting Fabry-Perot interference filter having seven layers, wherein each of the seven layers is a continuous, discrete sputter-deposited layer directly contiguous with its adjacent layers without an intervening nucleation layer, the first, third, fifth and seventh layers being dielectric layers comprising indium oxide, the first and fifth dielectric layers being from about 30 to about 70 nm thick and said third dielectric layer being from about 70 to about 100 nm thick, each of [p. 6] said dielectric layers having an index of refraction of from about 1.75 to about 2.25, and the second, fourth and sixth layers being transparent silver layers from about 4 to about 17 nm in thickness.–

Please add the following new claims 38-42.

–38. A visually transparent, infrared reflecting composite film comprising a transparent support having adhered tc one surface thereof an interference filter having a plurality of continuous directly contiguous stacked layers, said layers comprising:

a. a dielectric layer.

b. a discrete sputter-deposited transparent metal layer.

c. one or more pairs of layers, each pair comprising a dielectric spacer layer and a discrete sputter-deposited transparent metal layer, and

d. a dielectric outer layer, wherein the dielectric is a sputter-deposited dielectric; the metal layers each comprise silver and each are from 4 to 17 nm in thickness and the dielectric layers each have an index of refraction of from about 1.75 to about 2.25 with the spacer layers having a thickness of from 50 to 110 nm and outer layers having a thickness of from about 30 nm to about 70 nm.

39. The visually transparent infrared reflecting composite film of claim 38 wherein (c.) said one or more pairs of layers is one pair of layers.

40. The visually transparent infrared reflecting composite film of claim 39 wherein the metal layers are from 10 to 12 nm in thickness.

[p. 7] 41. The visually transparent infrared reflecting composite film of claim 38 wherein in (c.) said one or more pairs of layers is two pairs of layers.

42. The visually transparent infrared reflecting composite film of claim 41 wherein the metal layers are from 5 to 10 nm in thickness.–

Remarks

At the outset applicants' attorney wishes to thank the Examiner for the clarity of the Office Action under reply. The allowance of claims 5, and 26-35 is acknowledged with appreciation. It is believed that the above cancellation of claims and amendments to claims 14 and 26-35 resolve all of the issues so clearly raised in the Office Action. This paper also presents several new claims which should be allowable at this time.

Matters of Form

Claims 26-37 were previously submitted without being completely underlined. Claims 26-35 have now been submitted completely underlined. Claims 36 and 37 have been canceled.

Claims 14-16 were objected to, ostensibly for depending upon a rejected claim. Claim 14 is now recast in independent form. Claims 15 and 16 depend only from claim 14. This should resolve the objection and render claims 14, 15 and 16 allowable.

Patentability Over The Art

Claims 1-4, 6-13, 17-25, 36 and 37 were rejected over the art and are now canceled.

The New Claims

New claims 38-42 are now submitted. Claim 38 is an independent claim. It is formatted exactly like the [p. 8] independent (allowable) version of claim 14 which is now submitted. Claim 38 differs in scope from claim 14 in the following singular particular: Claim 38, third last line, specifies a spacer layer thickness of 50-110 nm while claim 14, third last line, calls for 70-100 nm. The 50-110 nm range is directly recited in the specification at column 5, line 6. It is not seen that either of the two primary references, Chang or Farges, is more relevant to claim 38 than to allowable claim 14.

Claims 39-42 further limit claim 38 in essentially the manner that allowable claims 15 and 16 limit claim 14.

Conclusion

It is respectfully submitted that this amendment places this application in condition for allowance. Such action and the issuance of an appropriate Reexamination Certificate including Claims 5, 14-16, 26-35 and 38-42 are requested.

Respectfully submitted,

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